POWER

Volume 66 New York, October 18, 1927 *Number* 16

Modern Magic

IN THE old days those who profited by the credulity and superstition of the people produced all kinds of wonders by the waving of a wand.

The modern prestidigitator has retained the wand, but foregoes any claim to supernatural qualities for it and frankly challenges his audience to fathom his acknowledged trickery.

Shortly before his recent death, Judge Gary waved his hand over a crystal globe and started a steel mill four hundred miles away.

There was no special potency in his hand. Any other hand, any other source of equal warmth, would have affected the delicate device within the globe and made it motivate the chain of mechanism that set the mill in motion.

There was no implication of Satanic complicity in it. Magic has become, as Leontes would make it, "an art lawful as eating."

But what a sorcerer Judge Gary would have been to the witch hunters and black-art sleuths of not so long ago!

About as astounding a demonstration of supernatural prowess as a necromancer of old could have made to a royal patron would have been to enable him to converse with a friend in a distant city. Can you imagine how complete would have been His Majesty's admission of the power of magic and his awe of the magician when he recognized a well-known voice, received intelligent replies to his questions and perhaps saw the face or at least the signature of his communicant.

There has recently been completed at London a successful test of short-wave wireless beam stations put in by the British Post Office for communication with India. Experiments have proved the possibility of carrying on wireless telephone communication by means of the beam stations, and the Marconi Company holds out the hope that there is a prospect of written and printed matter, drawings and photographs being transmitted to all parts of the Empire by high-speed wireless telegraphy.

The Indian scout who carried a message written on a piece of wood was astonished at the ability of the white man to make a chip talk. From the toilsome communication of the post, through the slow recording telegraph of Morse, the sounder, the telephone, the radio; from the chip to the wave in the ether, there has been continual progress from the material to the ethereal, from the obvious to that which is mystical to all but the initiated.

F. R. Low

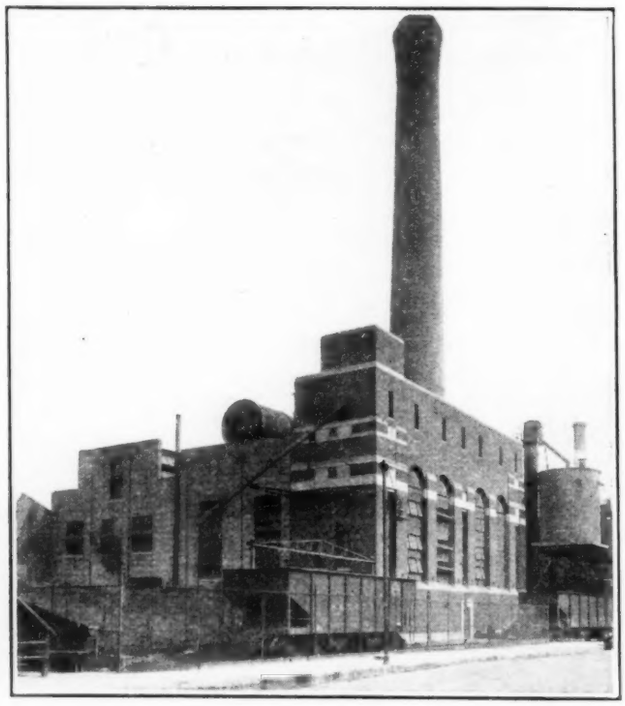


Fig. 1—Exterior of power plant showing outdoor coal storage, drag scraper at left and ash hopper at right

Combining Power *and* Process Steam

For Making Shade Cloth

In a 1,500-Kilowatt Poppet-Valve Engine Plant Exhausting at 2- to 30-Pounds Pressure to Process. Twelve Months' Experience in Powdered-Coal Operation Related. Engine Vibration Experienced from Faulty Cylinder Lubrication.

By Fred A. Krehbiel

THE Western Shade Cloth Company, of Chicago, requires large quantities of steam at 100, 25 and 2 lb. for bleaching and drying. The power demand also is comparatively large. In view of the low electric rates available in Chicago the question of purchasing power and generating steam as against meeting all requirements from a complete plant were considered. Preliminary estimates showed the latter to be the more economical, and the operation of the new plant has proved this to be true.

It is not the purpose of this article to describe the plant in detail, but rather to bring out some of the unusual points met with in its design and operation. The plant consists of four 5,000-sq.ft. water-tube boilers set singly and equipped with superheaters designed to give 100-deg. superheat when the boilers are operating at 200 per cent rating. The working pressure is 200 lb. gage. Each boiler is served by an impact pulverizer having a capacity of 4,000 lb. of coal an hour. The pulverizer is supplied with warm air taken from the hollow floor of the furnace. Aside from this small amount of heat no drying of the coal is attempted. The furnace has a width of 9 ft. and in round numbers a volume of 2,500 cubic feet.

In the engine room the equipment includes two poppet-valve engines, 28x30-in., directly connected to 500-kw. three-wire 250-volt direct-current generators, and two 21x21-in. engines of the same type driving 250-kw. generators. These engines are designed for operation at any back pressures from atmospheric to 30 lb. and are equipped with link motion on the exhaust valves for changing the compression while the engines are in operation for any of the several back pressures.

Two exhaust headers parallel the line of engines, and each engine is connected to both headers. Some of the engines operate on the low-pressure header at $2\frac{3}{4}$ lb., while others operate on the high-pressure exhaust header at a pressure of 25 lb. The low-pressure header is connected to the open feed-water heater and to atmosphere, and the excess of steam in the high-pressure exhaust header is discharged through a relief valve into the low-pressure system.

Flexibility Was the Deciding Factor for Powdered Coal

One of the major problems confronting the engineers and owners at the time of preparing the original estimates was whether the boilers should be equipped for burning pulverized coal or with stokers. The first cost of the former was considerably in excess of the investment required with stokers, but the calculated higher efficiency of the pulverized-coal equipment under local conditions was figured to just about offset the higher capital charges. Thus the preliminary figures indicated that the actual operating expense with either stokers or pulverized coal would be about the same. The latter equipment was chosen largely in the belief that it possessed greater flexibility in meeting sudden changes of load, as the steam demand in the station is subject at times to violent fluctuations.

Furnace side and front walls were provided with horizontal air passages, the former receiving air from the boiler room through controlled inlets and passing it on to the furnace through openings in the front-wall ducts. The floor of the furnace was built with air channels through which the pulverizer fan takes a portion of the

air. This was done for the double purpose of cooling the floor to minimize slagging and to supply a moderate amount of heat to the air entering the pulverizer.

Adjusting the Pulverized-Coal Burners to Protect the Brickwork

From the ignition arch through which the powdered coal is admitted, to the floor of the furnace, the vertical distance is 26 ft. The long flame of the burners originally furnished, caused slagging of the ash on the floor of the furnace at slightly less than 200 per cent of boiler rating. With the burners set as shown in the sectional elevation, there was some erosion of brickwork on the front wall, but the side walls were not affected adversely by the flame.

To obtain higher ratings, a shorter-flame burner was substituted for the original, which operated on the principle of impinging two streams of coal against each other. The new burner solved the difficulty of slagging ash, but played havoc with the front walls until by trial it

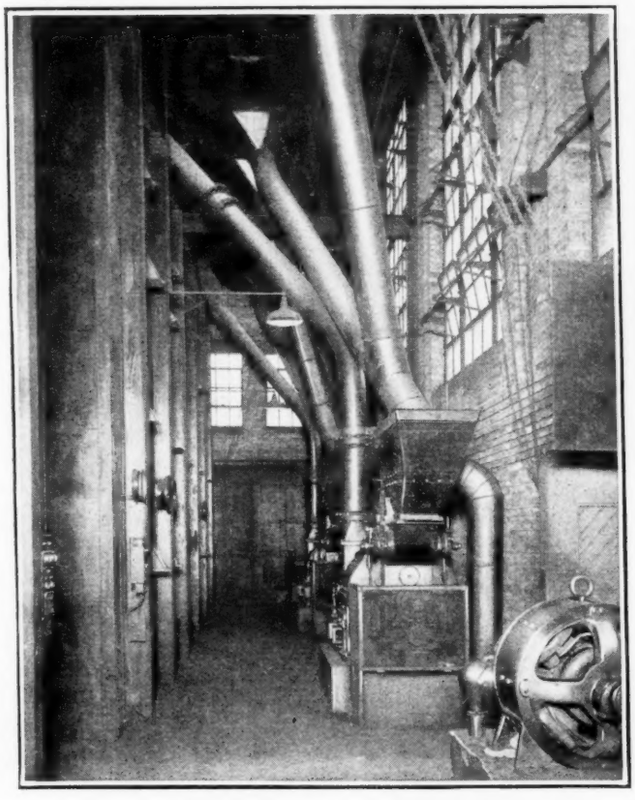


Fig. 2—Two of the boilers with pulverizers directly in front

could be tilted at the proper angle to save the wall and at the same time not permit the gases to reach the tube banks too soon. As now set and adjusted, the burners operate without destructive effect on the brick setting, and no further trouble from this source is expected. In future designs of a similar setting the writer would bring the front wall about 18 in. farther out. This should permit operation up to 250 per cent of rating without injury to the front wall and without producing objectionable smoke.

In the original equipment a short section of the pulverized-coal blast pipe immediately above the burners was made of galvanized iron. Within a few months this section was cut out by abrasion of the fine coal, while the rest of the blast system, consisting of standard wrought-steel pipe and fittings, has had no maintenance expense. From this experience it is evident that no light steel sections should be used in any pulverized-coal blast piping.

Capacities Vary with the Coal

All the pulverizers are supplied with coal as received from the mines or storage pile. Coals from Franklin and Saline Counties, Illinois, from Sullivan County,

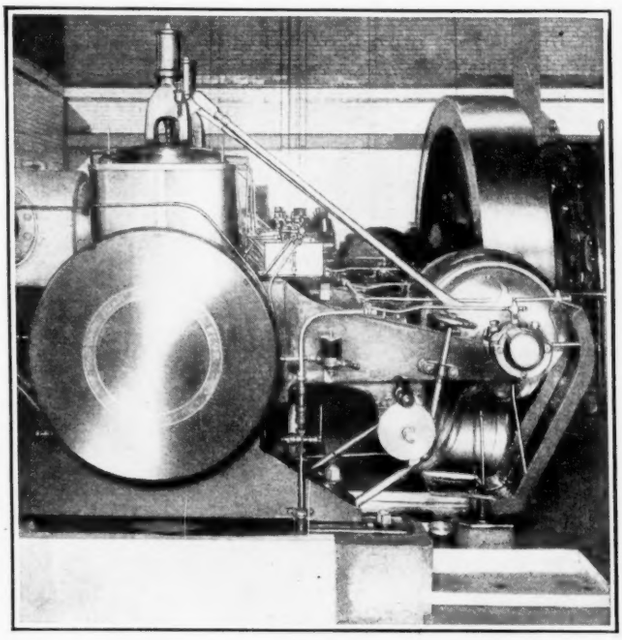


Fig. 3—End view of cylinder and valve gear showing ingenious device for varying the compression to suit the back pressure while the engine is in operation

Indiana, and from the western Kentucky coal fields have each been used separately for considerable periods of time. It has been found that the highest capacity as well as the lowest pulverizer maintenance could be attained with Saline County coal. Various sizes from 2- to $\frac{3}{8}$-in. screenings were pulverized.

With dry coal the maximum capacity attained was 240 per cent of rating. At this capacity there was no slagging in the furnace. The pulverizer and boiler are capable of higher capacities, but the limit is fixed by the making of objectionable smoke beyond this point. With $\frac{3}{4}$-in. screenings stored in the open through the winter and wet when fired, operation can be carried only to 160 per cent of rating, owing to the limitation of the capacity of the pulverizer. If this condition of extremely wet coal were to be met with more frequently or could not be controlled, then it would be advisable to install coal-drying apparatus.

Maintenance and Power Requirements

Over a period of twelve months the cost of pulverizer repair parts has amounted to 14.06c. a ton of coal pul-

verized. Of this total expense the hammer renewals alone amount to 4.03c. a ton. The rest of the expense is made up of linings in the grinding chamber and fan housing, new fan blades and new hammer disks.

Costing, originally, about $10,000 a boiler, the settings have had no more maintenance expense than is usually experienced with the well designed stoker-fired boiler installations.

Vibration from Poor Cylinder Lubrication Caused Trouble

Considerable trouble was experienced from the vibration of the engines which was imparted to buildings on the property as far removed as one block from the plant. The power-plant building, chimney and boilers rest on piling, but the engine foundation, which is a large mass of concrete 15 ft. deep and 80 ft. long with a maximum width of 24 ft., rests on natural clay. This clay is permanent water bearing, but firm enough to be classed as good foundation soil. The loading on the soil is so light that piling was not required.

When the two larger engines were running at slightly different speeds (150 and 154 r.p.m.) and when the pistons were moving simultaneously in the same direction, there was a reciprocating movement of the foundation clearly perceptible when standing on it. This motion was amplified at the top of the building and its motion was studied through the use of crude detectors that consisted of a swinging pendulum that was tuned to the engine's speed and by employing liquid in large bottles.

The disturbing vibrations were of sufficient magnitude to be felt clearly on the third floor of apartment houses about half a block from the plant and were discernible at greater distances through the action of more sensitively balanced objects such as window shades, loosely hung windows that rattled, and china plates set on edge that oscillated.

To overcome this trouble, counterweighting placed in the flywheel approximately opposite the crankpin was tried in varying amounts, and the vibration was materially reduced. Much to the surprise of all concerned, this condition did not remain constant and the vibration returned after a few days. This clearly indicated that the vibration was not caused by lack of counterbalancing of the reciprocating parts of the engine. Changes in valve setting, especially with regard to compression and admission, had been previously resorted to, and while adjustment of these elements had a material effect on vibration, nevertheless it was found that lack of adjustment was not the primary cause of the trouble.

About this time the piston and cylinder began to give indications of distress, and upon examination it was found that the top of the cylinder and the piston were not receiving sufficient oil. After supplying a new oil feed from the force-feed pump to the top of the cylinder at the mid-stroke and altogether removing the cylinder

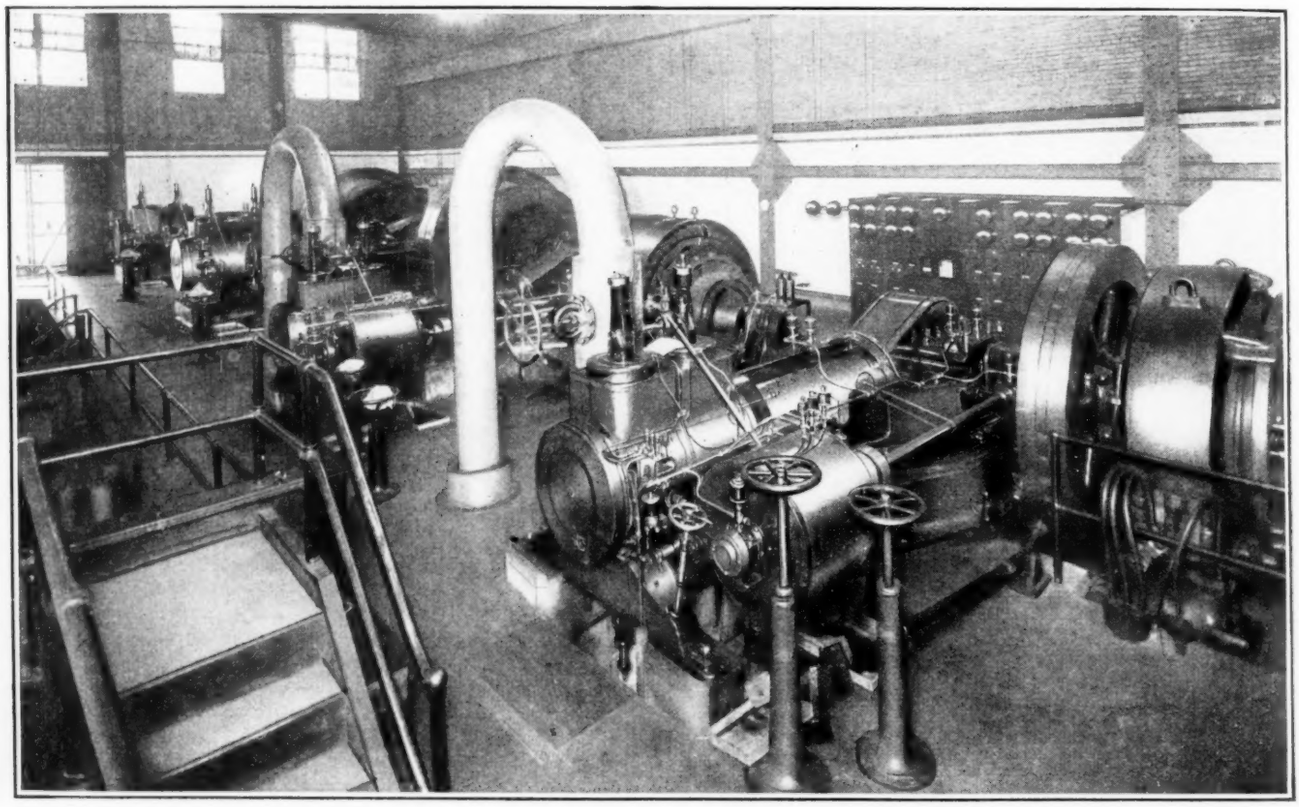


Fig. 4—Two 500-kw. and two 250-kw. generating units consisting of poppet-valve simple engines and direct-current generators

feed at the throttle, it was found that the cylinder was properly lubricated over its entire area. The cylinders were then rebored, new pistons fitted and worn in, and with the valve gearing properly set, little of the vibration remained.

Before the changes were made, each cylinder had been lubricated by a spray nozzle ahead of the throttle, which caused the oil to enter the cylinder as a finely divided mist intimately mixed in the superheated steam. There was provided also a cylinder oil plug near the bottom of the cylinder at the mid-stroke, with a steam jet designed for blowing the oil to the upper side of the cylinder; this oil also would, of course, attain the temperature of the incoming steam. The lubricating system now employed forces the oil through the bottom cylinder plug without using the steam jet and a second oil inlet is used, as previously described, on the upper side of the cylinder.

With the former system of oiling, much of the oil was wasted through never reaching the cylinder walls but remaining as a mist in the steam; also such oil attained the high temperature of the steam within the cylinder. With the improved system the oil is allowed merely to ooze into the cylinder so that practically all of it remains on the cylinder walls and none of it is blown into to the central portion of the cylinder. Lubrication is improved because of the lower temperature of the oil and the greater percentage left in intimate contact with the surfaces requiring lubrication. It is the opinion of the writer that the vibration of the engines was caused principally by cylinder friction, since the correction of the lubricating troubles did away with practically all vibration.

Remote-Controlled Switching

By the use of remote-controlled electrical devices many of the difficulties common to this type of installation were avoided. The generators are controlled by motor-operated circuit breakers and the eight feeders to the factory by eight 2,000-ampere, double-pole solenoid-operated breakers. The machine bus, the distribution bus and all circuit breakers are installed in a long concrete vault below the engine-room floor. The machine breakers are as close to the machines as it was possible to place them. All control switches, meters and signal lamps are on a slate board on the generating-room floor. The plant is equipped with watt-hour meters and with a graphic wattmeter.

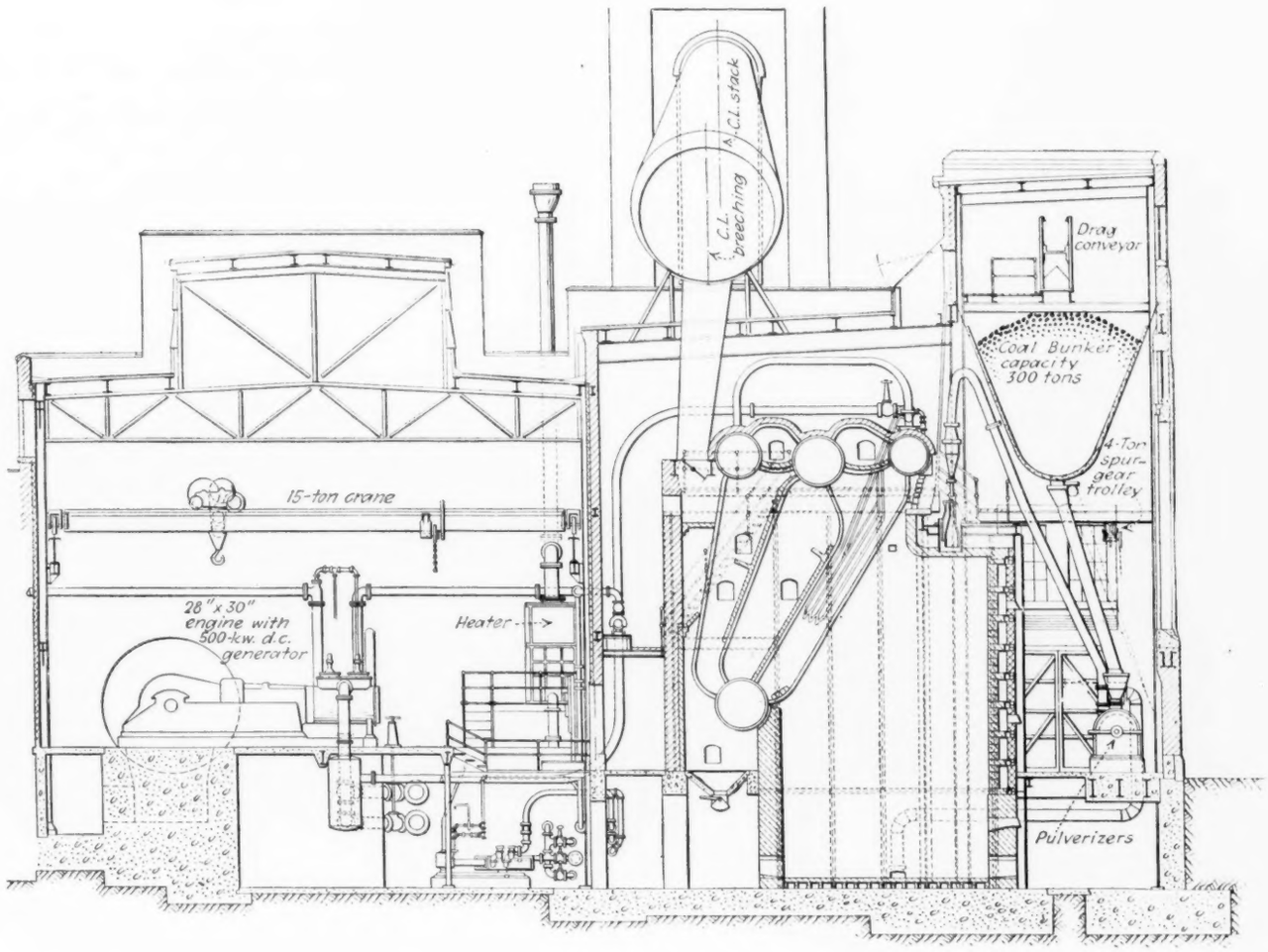


Fig. 5—Sectional elevation through plant

By the use of remote-controlled breakers the saving in space on the generating-room floor and the saving in cost of copper and labor that would otherwise have been required, much more than offset the increase in cost of the switching apparatus. Aside from economy of arrangement the switchboard is easily operated, there are no live electrical parts on the control board, and the whole ensemble presents an attractive appearance.

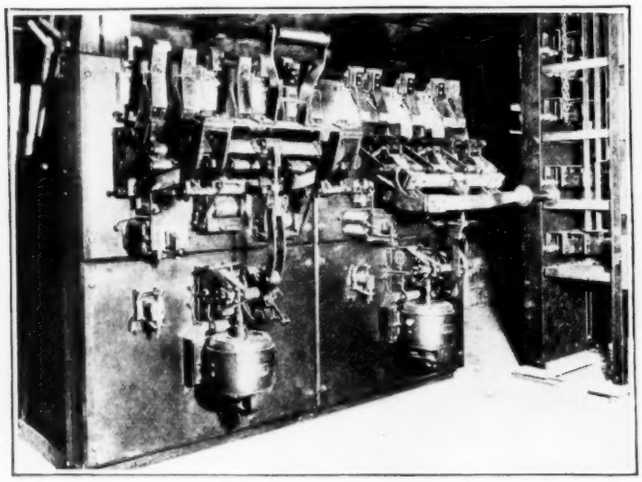


Fig. 6—Motor-operated circuit breakers for the generators

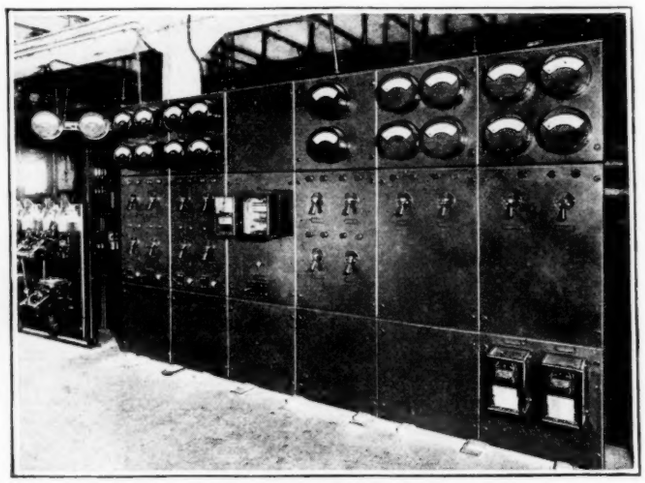


Fig. 8—An attractive control board on the generating-room floor

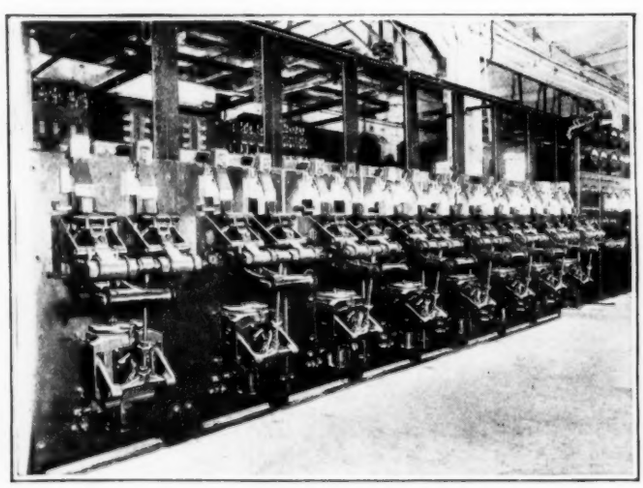


Fig. 7—Solenoid-operated breakers on the feeder circuits

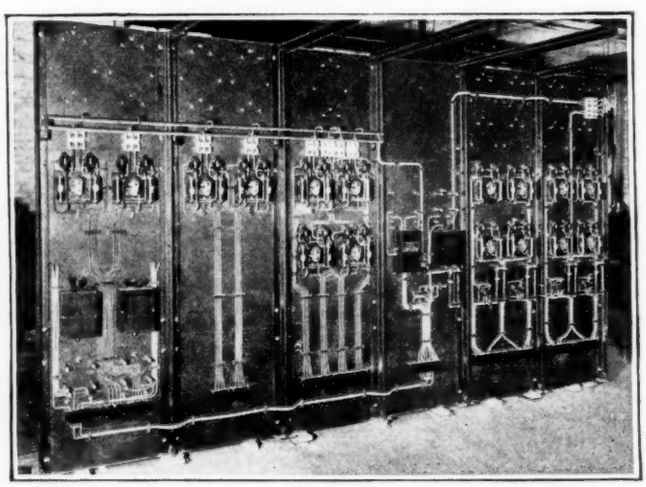


Fig. 9—Central board from the rear, showing the neat arrangement of the wiring

There are 415 motors in the factory aggregating some 4,000 hp. Of these 348 are constant-speed and 67 are variable-speed types. All are controlled by automatic starters and speed-control devices. The motors on the conveyors in the power house are controlled from three points, at any one of which all motors may be started, stopped or locked off in case someone is working on the machinery. Quite a number of the motors have individual inclosed circuit breakers in place of the customary fuses.

Exclusive of the building, the cost of the equipment of this plant was about $330,000. If this sum were divided by the rated capacity of the generators installed, it would produce an approximate equipment cost of $220 a kilowatt. For several reasons, however, this is a rather dangerous figure to use in the design of other plants. The requirements for steam in this factory for heating and industrial purposes are more than twice the requirements of the engines for generating power. The cost of piping, $56,000, is a large item because of the varied requirements of the factory for steam of three different pressures, hot and cold water, and compressed-air services. By omitting the extra boiler capacity and the process piping, the cost per kilowatt would have been in the neighborhood of $200, and this figure, for Chicago labor conditions, is higher than it should be for any other part of the country, with the possible exception of a few of the largest cities, which may have labor conditions comparable to Chicago.

The engineering work was done by the Krehbiel Company, of Chicago, and the design of the building by John B. Fischer, architect.

Some Shortcomings of South American Refrigerating Plants

By S. A. Enge

THE writer points out prevailing defects and gives an account of steps taken in rebuilding an old refrigerating plant and methods used to obtain the needed capacity

AFTER having been in charge of several large refrigerating installations, I feel that the outstanding defect of most of them was the absence of proper liquor and oil traps, purifiers and a high-pressure liquor pump.

In many of the installations it was almost impossible to draw off the oil properly, much less the entrained liquor and shredded packing which generally comes back to the suction line. The compressors generally operated wet; that is, the suction gas carried ammonia liquid to the cylinders, and the back pressures were low.

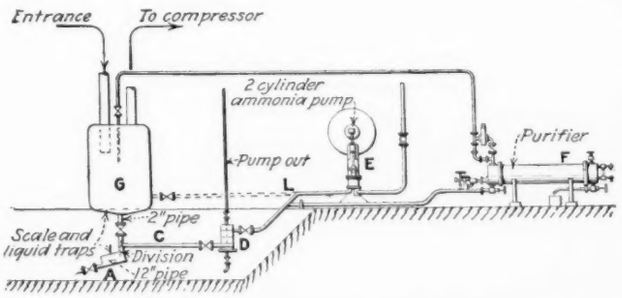


Fig. 1—Method used to remove oil from the system

The fact that the particular plants were rushed or that low temperatures had to be maintained, justified, in the engineer's opinion, such operating conditions. This opinion is another debatable question.

Some operated boosters at very low back pressures, simply passing the liquor to the compressor, which is almost as bad. This liquor evaporates in the booster compressor, by having work done on it through compression, which must require considerable power. Many plants had no liquor pump at all, while others that had them, discharged into some low-pressure unit such as a brine cooler or ice tank. Often, this made a load for the compressor when that unit could have been shut down.

In other plants no consideration was given to separating the oil from the ammonia, which liquor is unfit to be returned to the system. How is an engineer to know how much liquor the pump is delivering and how much must be supplemented by the expansion valves from the receivers?

One setting of the expansion valves will not hold good for long, as the pump may vary in its delivery from time to time. Under these conditions the coils may be either underfed or overfed, which is neither an economical nor a desirable way of operating. From this we can deduce that a system that would successfully trap all liquor and oil, separate the oil from the ammonia and return the ammonia to the liquor line, would be an ideal installation.

The compressor would operate dry under these conditions, metallic packing would be successful on rods 5 in. and over in diameter, and the amount of lubricating oil would be reduced to an absolute minimum. No packing could get into the system to block up the expansion valves, oil would be a thing of the past, and several other worries of the average engineer would be over. The same operating results would be obtained on higher back pressures, less compressors would be required, and the prime mover would carry a greater percentage of its rated load. All this would lead to direct economy in fuel.

These have been my views for some years, and when I was engaged by a firm to place their refrigeration plant

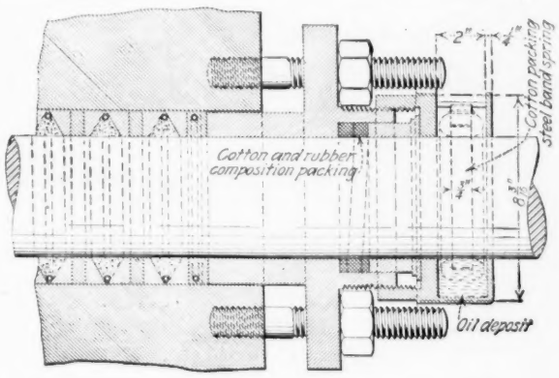


Fig. 2—A wiper ring was placed on the piston rod

on something like an economical operating base, the opportunity of putting these ideas into effect presented itself. The changes were made, and the plant is working so satisfactorily today that some engineers might be interested in the details of the change. The entire program was carried out under heavy operating conditions, and the cost was not great, considering the benefits derived—namely, reduction from 50 to 75 per cent in the items of fuel, labor and supplies.

The plant had a rated capacity of 1,034 tons of refrigeration, 700 tons in three Ball Giant compressors, and the rest in old De La Vergne units. The plant dates back about 24 years, when it was apparently a small

establishment. As the industry grew it was enlarged, but when making additions no economical or even intelligent ideas of linking the old with the new were employed. This resulted in a mechanical assemblage that was neither economical nor easy to operate. This was true, not only of the refrigerating department, but also of the boiler room, pumping, compressed air and the power installations. The suction piping of the refrigeration end was so complicated that it would be impossible to describe or make a plan of it.

Some freak attachments existed which were superfluous in the extreme. One in particular was a set of ammonia receivers, holding 10 tons each, having 3-in. ammonia piping and valves by the dozen. The receivers were made of 1-in. plate, double-strap, quadruple-riveted. These receivers were never used, for the simple reason that the system never contained enough ammonia and, secondly, they leaked.

The multiplicity of valves and fittings of this suction piping made it difficult to keep ammonia in the system.

Shortage of ammonia is the cause of many difficulties, and this plant surely had its. As can be imagined, all the compressors, six in number, were operating, and the back pressure was about 2 lb. gage. This took a heavy toll on supplies, steam, labor, water and repairs, all of which cost the firm a neat sum of money each month. No engineer, however clever, could operate this plant economically in the condition in which it then was. Had the ammonia charge been complete, higher back pressures could have been carried and less compressors operated.

The plant carried only one back pressure, although the tonnage was equally divided among brine tanks, cold-air batteries, and direct-expansion coils, all of which were carried at freezing temperature. The space under refrigeration was about two million cubic feet.

Temperatures ranged anywhere from 30 to 0 deg. F., and the refrigerating load entering the rooms varied anywhere from nothing to 500 tons per day.

A good old gang of pluggers were in charge. The motive power department had about 74 men, representing ten or more different nationalities, a real League of Nations. The place looked clean and prosperous, but operating costs were high. They had gotten into a rut by not keeping up-to-date, and after the old chief died we took possession.

Some of the men had been in the place 22 years, and it was not with great joy that the newcomer was hailed.

However, they were not long in finding out that something very interesting was on the boards. The day of watching the clock with one eye and the boss with the other was over. Every man was impressed with the idea that he was partly responsible for the work being carried out, and education was freely handed out to those who sought it. Not one single man of the old gang left the service, and none but will acknowledge that his lot in life has been materially improved.

About 21,000 lb. of ammonia was charged into the system as quickly as we could get it there. Matters improved immediately. Back pressures were boosted and a couple of compressors were shut down, together with

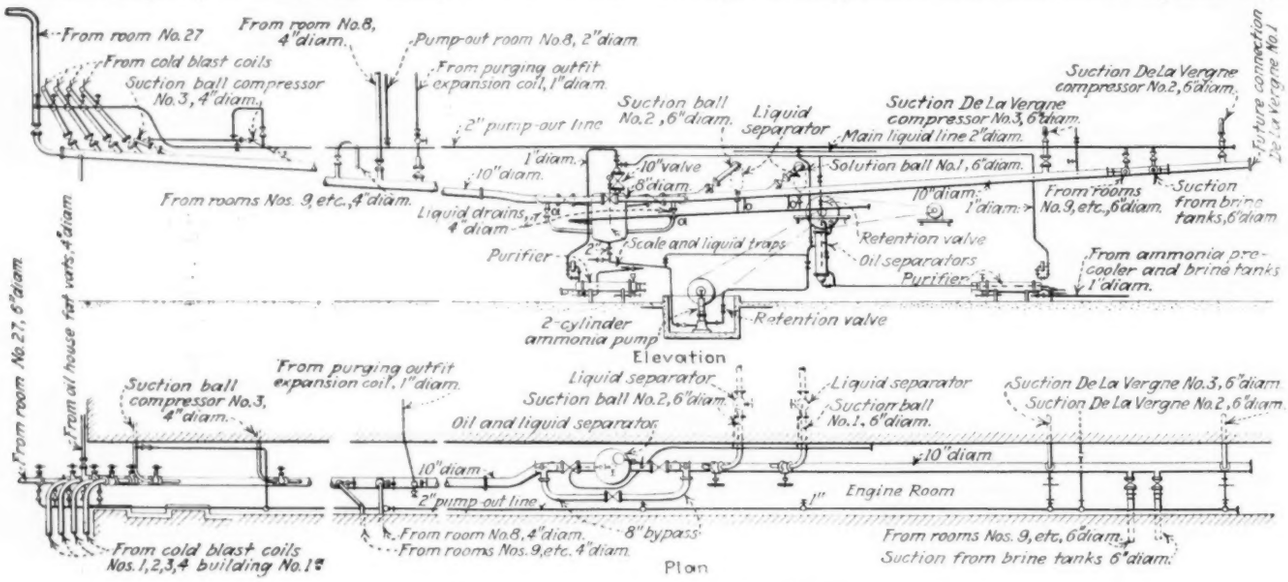


Fig. 3—New layout of the suction lines

as many boilers. The money that had been expended on ammonia was coming back to the till faster than we had expected. Our ammonia charge being about as sacred as Buddha is to the Hindoos, we immediately made provision to hold it at any cost.

An ammonia man was invested with the responsibility of reporting all ammonia leaks directly to headquarters and at the same time of getting them repaired. On the engineer's desk a book was kept into which all leaks were recorded and when repaired, or were classed as a week-end shutdown repair. We succeeded in preserving the ammonia charge by this simple expedient. The compressors were operating reasonably warm, but it was seen from the start that some radical changes in the installation would have to be made before we could expect anything like uniform temperatures. There were also three or four other items which, in our opinion, required immediate attention.

From the great amount of compressor oil used in times past and the small amount taken from the system, it was apparent that the expansion coils would have to be cleaned. An ammonia purifier was connected to one of the old liquor traps, as shown at *F* in Fig. 1. This was

intended as a temporary installation, since we were thinking of tearing it out again as soon as we could carry out our original plans. A home-made residue collector *A* was connected to the bottom of the large trap as shown. The 2-in. pipe below the valve had a division which compelled the ammonia to enter the trap *A* dropping solids and oil and proceeding up the same pipe to find an exit through pipe *C* into filter *D*. This filter contained three plates, one above the other, held in place by a long stud attached to the bottom cover. Each plate had different-sized holes, the first plate having the largest and the last the smallest holes. From the filter the line *L* led to the purifier to which all the liquor flowed by gravity. The gas from the purifier returned to the top of the big trap *G*. Pump *E* is shown connected to the old trap *G* by the dotted lines. This was part of the old

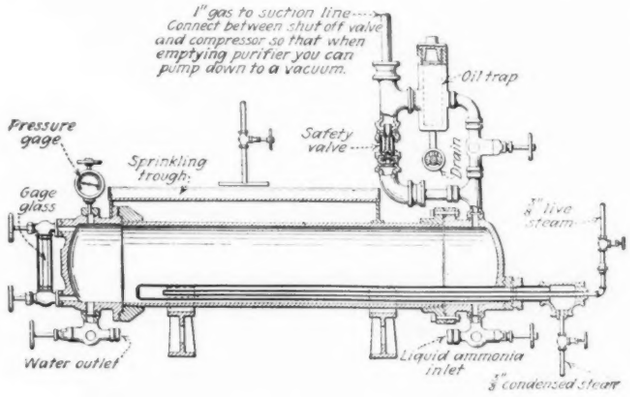

1" gas to suction line—Connect between shut off valve and compressor so that when emptying purifier you can pump down to a vacuum.
Oil trap
Pressure gage
Safety valve
Sprinkling trough
Drain
Gage glass
1" live steam
Water outlet
Liquid ammonia inlet
1" condensed steam

Fig. 4—A sprinkling trough replaced the inside steam coils

installation, and never operated, for reasons that must be clear to every refrigerating engineer, the pump being set entirely too high for the trap. Although the operation of the purifier was very slow, we succeeded in removing over six tons of oil and packing from the system during the time it was in operation. The oil was filtered and re-used, resulting in a considerable economy of lubricant.

Another purifier was connected to the bottom of the brine tank coils and fore-cooler; this, however, is not shown. These coils were so full of packing that nothing could be done except remove the ammonia and blow steam and air through them to clean out the packing. A record of the amount of stuff removed from each purifier was made so that a check could be kept of the efficiency of their operation.

When installing the purifiers, we also replaced the cotton-and-rubber ammonia packing of the Ball compressors with flexible metallic packing. This was but a temporary measure, since it was our intention to install straight metallic packing rings as soon as they could be obtained from the states. It was necessary also to bore out the cylinders, fit new pistons and turn down the rods, all of which would have to be done during the slack part of the season. We shortened the oil lanterns to 5 in. and replaced the bottom white-metal ring with one made of cast iron, split diagonally. This ring we found did not break, whereas the white-metal ring was continually giving trouble. The entire oiling system, consisting of a hand oil pump to the lantern, a gravity oil tank hung on the wall which also fed to the lantern, and a sight-feed oil cup to the stuffing box, were removed. In its place we used a wiper ring held in front of the gland by a fork as shown in Fig. 2.

This wiper was made by winding 1-in. cotton packing around a spring-steel band which would hug the rod. It was kept saturated with a pot of oil and a brush, a division being made below so that any oil which dropped would not mix with the machine oil from the crosshead slides.

Operating dry, the discharge temperature was always around 230 to 270 deg. F. As only the Ball compressors were being used, there was no danger of getting packing or oil into the system. The cold-blast battery coils had also been cleaned, and a good purging outfit was working to perfection. Electric lights were also installed inside of the crosshead slide frames to illuminate the stuffing box. Permanent thermometers, indicator, planimeter, gage tester, mercury column and vacuum gage were installed, which simplified matters somewhat, as we had been working with temporary equipment. The suction-line thermometers were of the insulated-stem type, with a temperature range from 40 to 130 deg. F., since our engine-room temperatures went up to 125 deg. during the summer. All other thermometers were of the angle-stem removable-socket type, so that they could be removed any time work was being carried out around the machines.

The idea of redesigning the suction line was taken in hand. Considerable money had been granted to reinsulate all the ammonia lines, and it was found that this money alone would be sufficient to reconstruct the old lines and cover the new one. Thus the piping shown in Fig. 3 was designed and was made up of material about the plant.

The suction line has been in operation about a year, and as far as we have been able to calculate, it has saved us from one-half to three-quarters of a machine per day, which amounts to 120 to 180 tons out of a total of 705, a reduction of from 17 to 25 per cent.

In times past back pressures have been around 5 to 6 lb. gage; now we have an average of about 10 lb.

The oilers regulate the speed of the ammonia liquid pump by keeping the frost line below the suction flange of the tight and loose heads. The engineer controls the expansion valves in the usual way, except that a little more ammonia is given, but not more than the pump can conveniently handle. The pump is a two-cylinder affair, and trouble is encountered in the sense that once the pump is allowed to run dry, it will not pick it up again on its own accord against the condenser pressure.

The trouble lies not in the method of installation, but in the pump itself, which easily becomes gas-bound. The pump will not pick up the liquor again until this trapped gas is removed and the temperature of the cylinder is lowered. This condition requires a special design of pump, and I hope to design such a pump at a later date if the opportunity presents itself.

We cannot carry dual pressures, since we are freezing with the entire system, but this could be done by duplicating the line and making necessary connections.

The steam coils inside of the purifiers were removed and a sprinkling trough was installed as shown in Fig. 4. It was found that through carelessness the oilers were permitting the coil to freeze, thus bursting it, resulting in a loss of ammonia.

What Do You Know?

By L. H. Morrison

The answers are on page 604

BUTLER, in his novel "The Way of All Flesh," voices the belief that one can know too much. Quite possibly this is true when our knowledge is made up of a mass of unrelated and useless bits of information on a thousand different subjects. Little good this undigestive mass does other than give us a slight superiority complex. Engineers, however, can never know too much of engineering; such knowledge is more than bread and meat, it may serve as an admission card to "Who's Who?" The ten questions below may either increase your fund of information or reveal that the editor does or does not think as you do. If any of the answers are wrong, tell him about it.

Ques. 1—How would you clean the discolored surface of a brick chimney?

Ques. 2.—In expanding through an orifice the maximum weight of air discharged will occur when the low pressure is 52.5 per cent of the high pressure. Does the maximum velocity occur at the same pressure conditions? Why?

Ques. 3—A group of two or more polyphase motors is operating on a common line and one of the conductors of the line becomes broken, leaving the motors operating single phase. Could one of the motors in the group, after being stopped, be started again?

Ques. 4—Where does the greatest wear come on elevator cables?

Ques. 5—Who is president of the American Society of Mechanical Engineers?

Ques. 6—Why is a brass bushing recommended to be used on the feed line of a boiler at the point where it enters the boiler shell or head?

Ques. 7—What advantage is there in generating steam at 3,200 lb., as in the Benson boiler, if it is reduced to 600 lb. before use?

Ques. 8—Suppose a bleeder turbine is having 10,000 lb. of steam extracted and a sudden demand impels the withdrawal of 20,000 lb. Will the speed change?

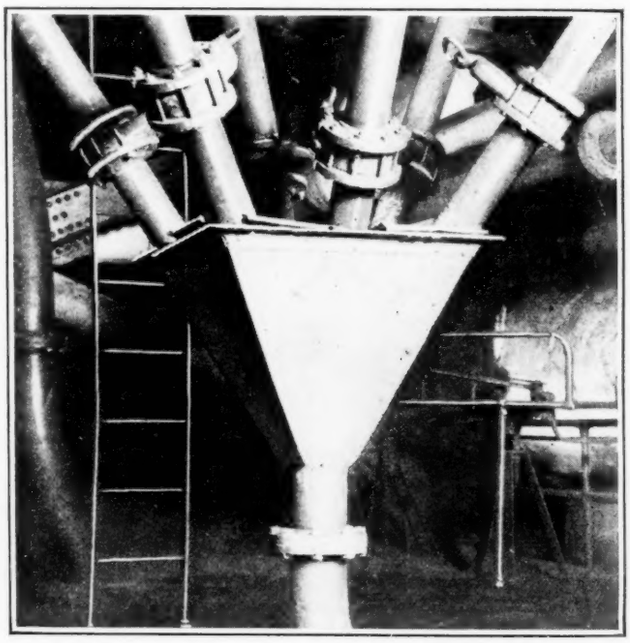
Ques. 9—Name three inventors of steam-engine shaft governors used in this country.

Ques. 10—Suppose you had a 125-lb. boiler plant in which the average load was 10,000 lb. of steam per hour. With a maximum of 15,000 lb. and a minimum of 5,000 lb., would it be economical to replace the simplex boiler-feed pump, using 100 lb. of steam per horsepower per hour, by an alternating-current motor-driven centrifugal pump having a combined pump and motor efficiency of 50 per cent, if current was produced by an engine-generator unit, consuming 50 lb. of steam per kilowatt-hour?

Economizer Soot Remover

THE location of the economizers in the Essex Plant of the Public Service Electric & Gas Company of New Jersey is such as to require considerable time and labor for the removal of the soot. Wishing to decrease the time and expense of removing the soot, led the chief engineer to consider various methods to accomplish these results. After careful consideration it was finally decided to remodel the steam-ejector system so that the soot could be removed by gravitation.

The foundation beneath the economizers was designed in three concave sections running crosswise of the economizer, and the four sides of each of these sections sloped toward the center, at which point a hole was made for the connection to the ejector system. This was removed and a 4-in. pipe was connected in each of these holes and dropped about 20 ft. to a common iron hopper on the



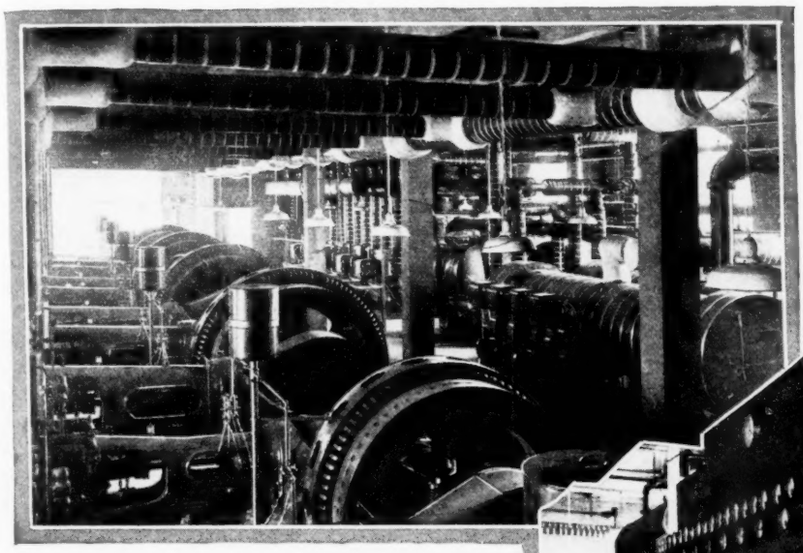
Arrangement of hopper and piping for the removal of soot from economizers by gravitation

floor below. Each of the pipes was equipped with a 4-in. valve to prevent the intake of air when the economizer was in service.

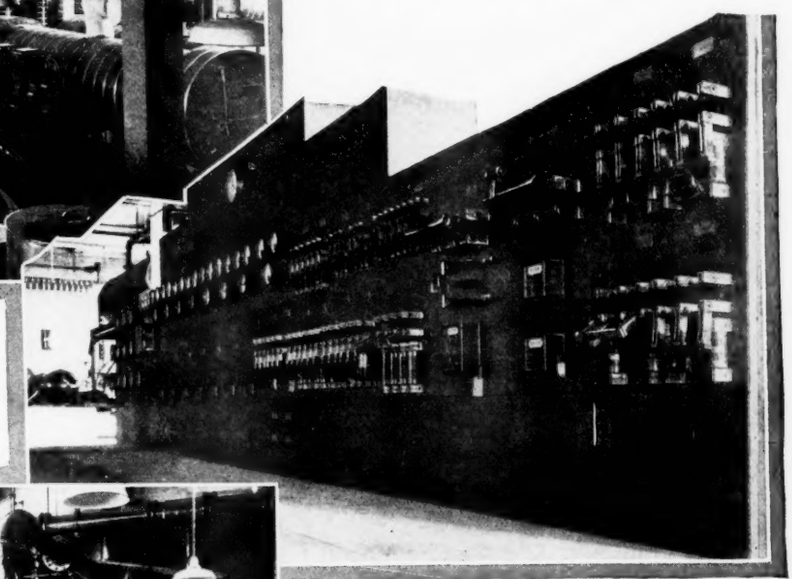
Four $\frac{1}{4}$-in. boiler plates were welded together to form a hopper with a top opening 30x24 in., a bottom opening of 6 in. and a depth of 24 in. A 6-in. iron pipe was connected to the base and dropped downward 35 ft. to the ashpit. This arrangement permitted the soot to be deposited into an ash car directly.

POWERGRAPHS

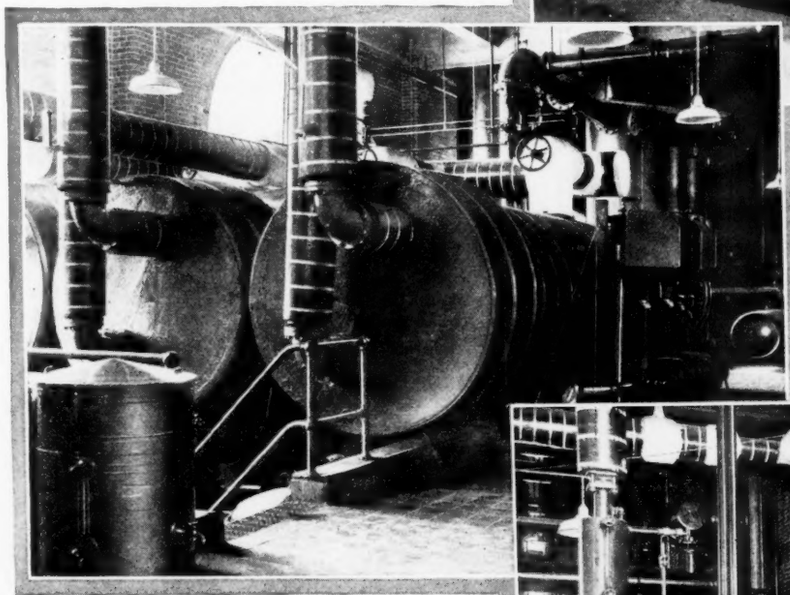
Refrigeration at Bronx Municipal Market



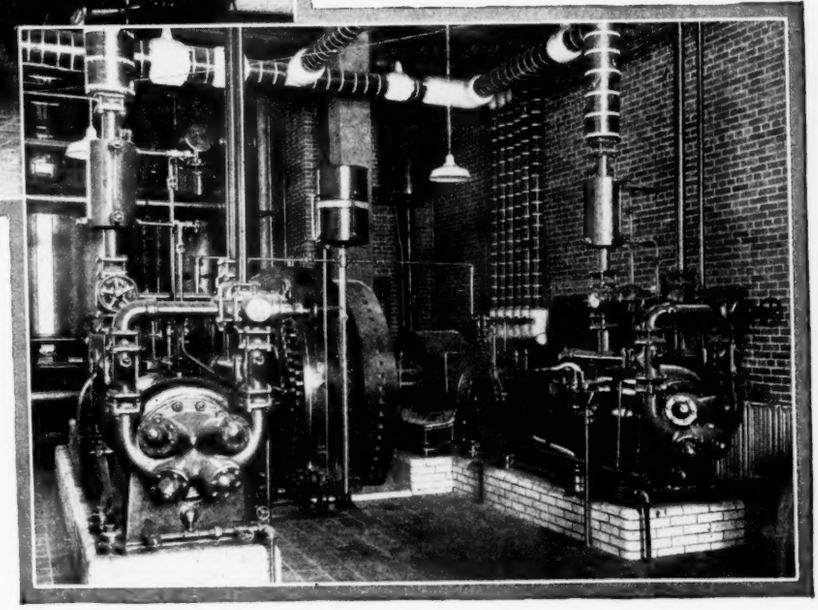
This is the largest municipal cold storage plant in the world and one of the largest refrigeration plants of any character. It serves exclusively New York's food supply.



Above—Floor view of ice plant showing ammonia compressors that provide 1,035 tons daily.



Above — Front view of electrical switchboard system.



Above—Two brine coolers of the shell and tube type.

Right — One of the ammonia compressor units.

ELECTRICAL *Operation and Maintenance*

Selecting

Power Equipment

for a

Modern Hotel

By GERALD I. CARPER
Industrial Department, General Electric Company

THERE are 800 rooms in the new Parker House in Boston, connected with the older Parker House annex, which provides an additional 100 rooms. The structure is 13 stories high, reaching the Boston height limit of 155 ft. Direct current enters the building in the sub-basement through six 2,000,000-circ.-mil cables, and is supplied by the Edison Electric Illuminating Co. at 110 and 220 volts.

On the main distribution switchboard there are 41 fused feeder circuits, and six watt-hour meters are provided to measure the power consumed by the various classes of equipment. Through these individual meters it is simple to isolate sources of extravagant power use. The meters are read daily and any unusual variations from normal readings are immediately traced.

There is a total connected load of 925 kw., of which 615 kw. represents power load, the remainder being the lighting load. The average load is 540 kw. and the annual consumption is approximately 1,500,000 kw.-hr. indicating a load factor of about 58 per cent.

From the main service board the power is distributed through 47 lighting panels and 12 power panels. The lighting panels are of the solid neutral type and have fuses and tumbler switches in all branch circuits. The cabinets are of double-door construction, thereby providing full safety-type panels. There were used 557,800 ft. of hot-dipped, galvanized conduit in the building, and only 210 ft. is exposed.

Approximately 2,000,000 ft. of wire and cable was used varying in size from the 2,000,000-circ.mil lead-covered entrance cables to the common code wire used for lighting circuits. Altogether there are 8,000 electrical outlets in the building; it takes 12,500 lamps to fill all the sockets, and there are 86 motor units.

ELEVATORS AND DUMBWAITERS

The vertical transportation system consists of four passenger, two service and one freight elevators, one trunk lift and one ash lift. The four passenger machines are of the variable-voltage, automatic speed-regulated, gearless-traction type, providing smooth operation.

In the elevator penthouse, Fig. 6, are shown the four motor-generator sets with control panels and gearless machines on the lower level with one of the service machines in the upper right-hand corner. The passenger machines are rated to carry 2,500 lb. at 600 ft. per min. Each elevator motor is tied electrically to a 40-kw. generator driven by a 25-hp. motor. All speed variations of the passenger elevators, six points in each direction, are obtained through generator field control.

Fig. 5 shows one of the traction machines. A rolled-steel magnet frame and a welded structural-steel base are used, giving maximum strength and superior magnetic circuits, together with a decrease in weight as compared with cast construction.

The two service elevators are geared, rheostatic controlled machines, one of which is rated 2,500 lb. at 500 ft. per min. and the other, 3,000 lb. at 500 ft. per min. All speed control on these cars is obtained by inserting or removing resistance from the armature circuit. The freight elevator, which handles supplies, runs only from the sub-basement to the mezzanine floor. Its rating is

ELECTRICAL *Operation and Maintenance*

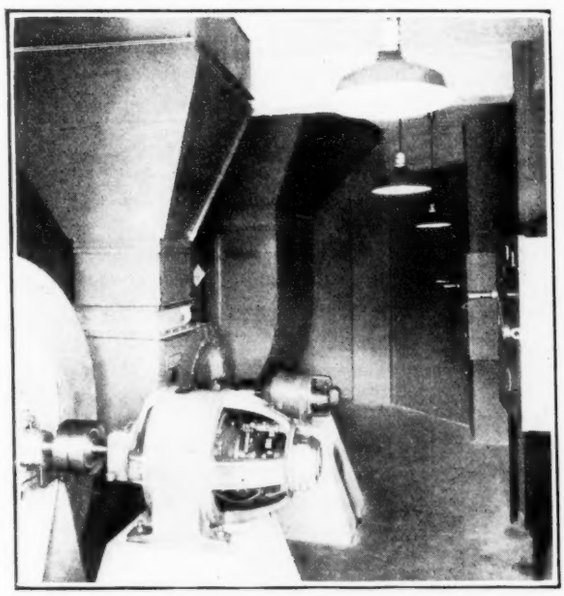
4,000 lb. at 55 ft. per min., and it is driven by a single-speed motor.

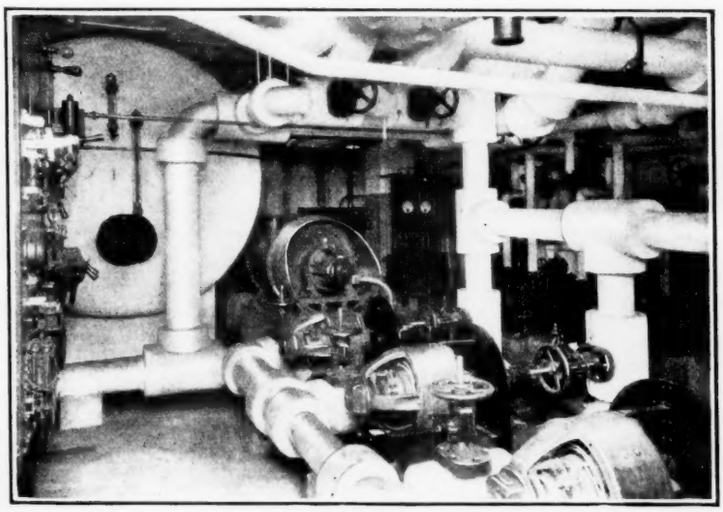
The ash lift and the trunk lift both run from the street level to the sub-basement. They are rated 1,500 lb. at 50 ft. per min., but, inasmuch as they are not counterweighted, each requires a 17½-hp. motor to drive it, and both machines are push-button operated. Two dumbwaiters, operating from the basement to the mezzanine floor, have capacities of 150 lb. at 75 ft. per minute.

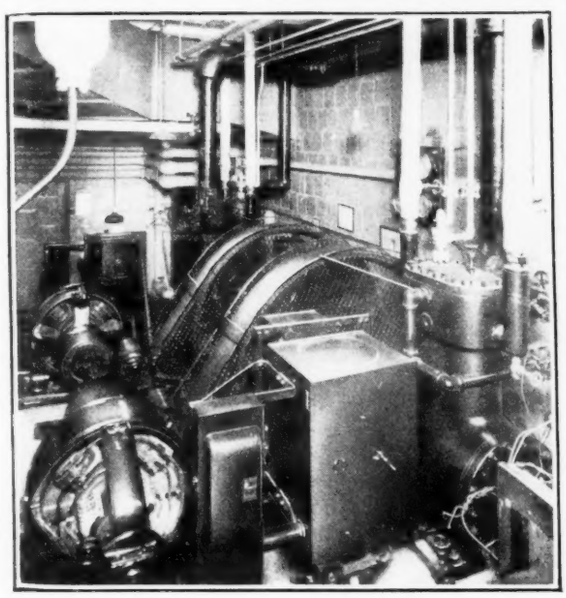
The passenger signal system is of the ordinary flashlight annunciator type, but has an added feature by means of which a car must stop at the floor for which the stop signal is set, to put out the light. So-called "fade-light" indicators are provided on the ground floor so that the starter knows at all times the position of each car in the hoistway. Ordinary lanterns are placed on the other floors.

Heating and Ventilating

A coal-burning plant was selected for heating the building rather than oil, as the owners were afraid of the soot that oil might create. Pulverized coal is used under two 3,500-sq.ft. water-tube boilers which can be operated at 175 per cent of their rating. It is anticipated that approximately ten tons of coal a day will be used during cold weather. At the present time there is no laundry, therefore most of the steam is used for heating the building, but some is used for keeping the serving cabinets and trays warm. However, provision has been made for a laundry which will be installed later.







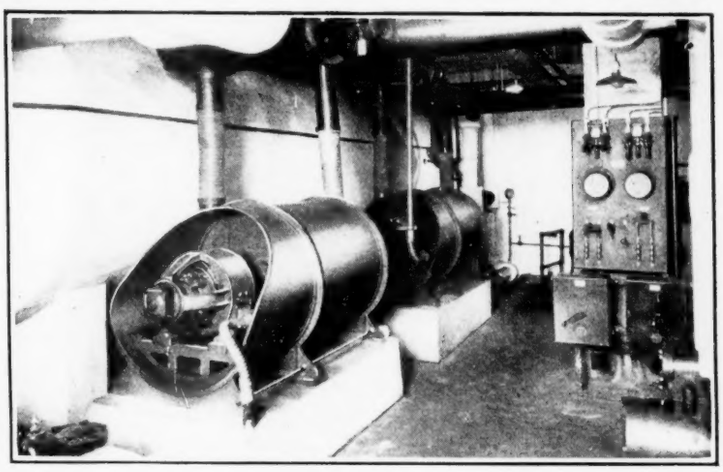


Fig. 1 (Upper left)—Exhaust fans in penthouse
Fig. 2 (Upper right)—In the foreground three motor-driven combination fire and booster pumps
Fig. 3 (Lower left)—Refrigerating machines
Fig. 4 (Lower right)—Two vacuum cleaner exhausters

ELECTRICAL *Operation and Maintenance*

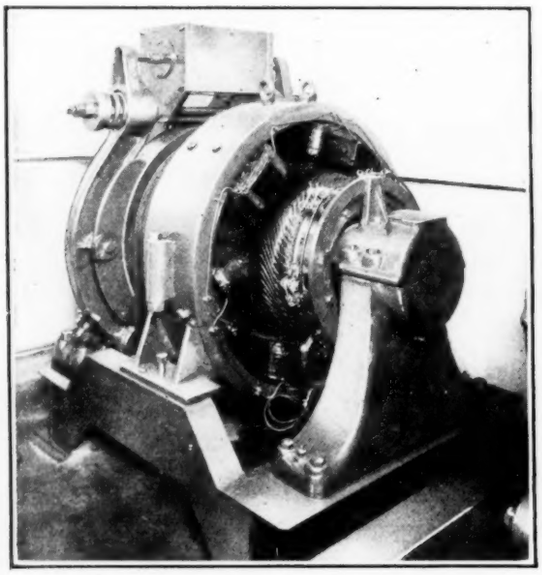


Fig. 5—One of the passenger elevator machines

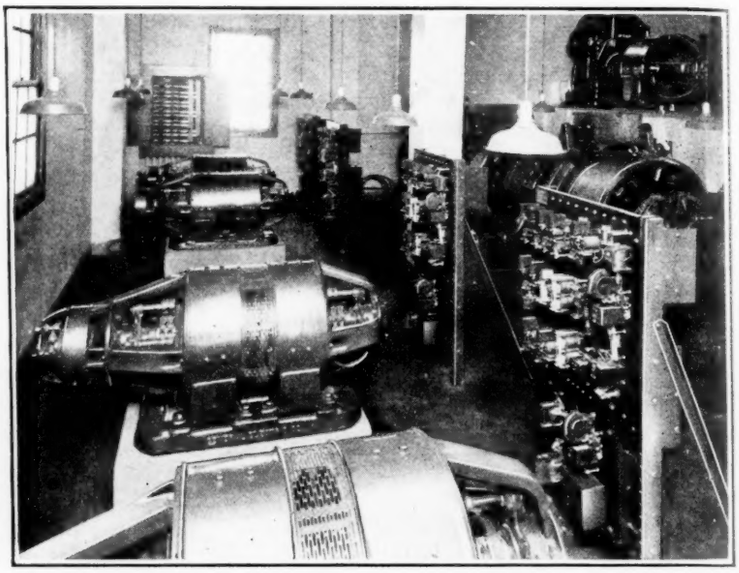


Fig. 6—Elevator machines, control panels and variable-voltage motor generator sets

A two-pipe vacuum return-line system is used for heating on account of its flexibility and economy of operation. Two 7½x5x10-in. duplex-horizontal steam pumps and two 10x14x18-in. single-horizontal steam vacuum pumps are used. All public parts of the building are heated by both radiation and forced-air circulation and the rooms are heated by radiation only.

Fig. 1 shows one of the roof penthouses, which contains three of the 18 ventilating fans. Fifteen of these are exhaust and three are supply fans. All units but one have slow-speed, direct-connected motors, and those on the roofs are all remotely controlled by push-button stations, but they may be operated at various speeds by means of the present speed controllers. This makes it possible for the engineer to start and stop all roof fans from his quarters in the basement.

All public spaces and toilets are provided with washed air in addition to forced ventilation. The air can be warmed or chilled as it is forced to these spaces according to weather conditions. The waste ice water is used to cool the washed air in summer. Air in the main dining room is changed completely every twelve minutes. In the toilets it is changed every five minutes and in other parts of the house from three to ten times an hour. Hoods are placed over all stoves, and the air is exhausted from these hoods continually.

Motors on the fans vary in size from one-quarter to 15 hp. and total over 50 hp. capacity. Field control of speed is used on all but the smallest units in order to save power.

Refrigeration System

Two 50-hp., compound-wound motors with full field speeds of 680 r.p.m. are belted to the 25-ton ammonia compressors for the refrigeration system, shown in Fig. 3. Motors are provided with push-button starters and, in addition, have field rheostats for increasing the speeds 25 per cent. Each controller is provided with a full field relay so that the motor cannot be started with weakened field.

One machine ordinarily carries the load, and it is only on the hottest days that both machines operate. Besides supplying all the ice used in the hotel, these machines provide the running ice water throughout the building and the brine also circulates through 17 refrigerators in the various kitchens and butcher shops.

Duplicate brine pumps are driven by two 7½-hp. constant-speed motors. Circulating ice-water pumps are also provided in duplicate and are driven by 5-hp. motors. In addition to the main refrigerating plant there is a small ice-cream plant. This comprises a small compressor driven by a belted motor.

Fire and Service Pumps

Inasmuch as the city water pressure at the mains, 30 ft. below street level, is only 85 lb. per sq.in., it was necessary to provide booster pumps in order to provide service water to the top floors. These pumps are made to serve as combination booster and fire pumps, and a constant pressure of from 105 to 125 lb. per sq.in. is provided in the tanks at all times. Three centrifugal pumps with capacities of 350 gal. per min. are each driven by 15-hp. motors. Combination automatic and hand controllers are provided in accordance with the fire underwriters' rules. Each pump is pressure regulated; when the pressure in the tanks drops to 105 lb. one of the pumps starts and raises the pressure to 125, when the motor is shut down automatically. Fig. 2 shows these three pumps in the foreground of the picture with controllers at extreme left.

ELECTRICAL *Operation and Maintenance*

Motor-driven duplicate vertical sewage ejector pumps have a capacity of 350 gal. per min. and pump against a 40-ft. head. These pumps are started and stopped automatically according to the level of the float in the sewage chamber.

In Fig. 4 the two 20-hp. vacuum producers are shown, the control panel for both motors being shown at the right. These units provide for a vacuum-cleaning system of approximately 50 outlets. There is a small pneumatic tube system on which a turbine unit driven by a 5-hp. motor operating at 3,450 r.p.m. provides the compressed air.

The writer wishes to express his appreciation to Desmond & Lord, architects; Connor Electric Co., electrical engineers and contractors; Gurney Elevator Co., electric elevators; Cleghorn Co., heating and ventilating engineers and contractors; J. A. Cotter Co., plumbing contractors; and J. H. Rice, chief engineer of the Parker House, for assistance rendered in preparing this article.

Elevator Guide Rails Lubricated from a Master Reservoir

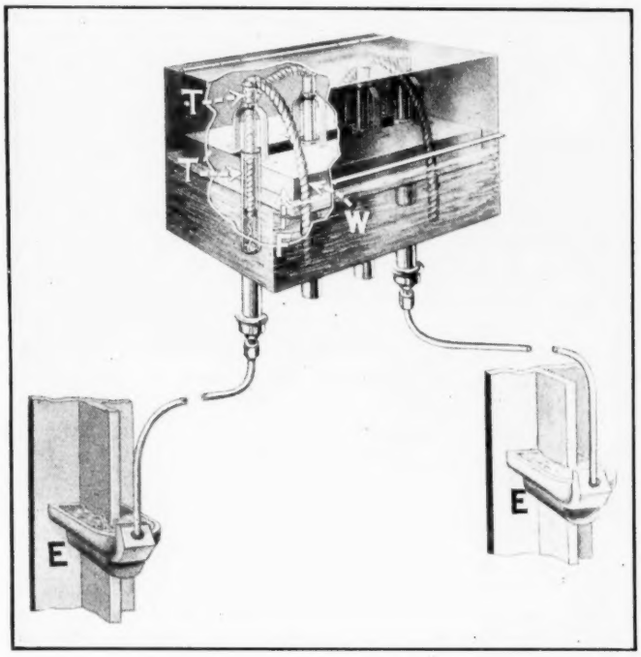
A REQUISITE to having equipment maintained is to arrange it so that it can be taken care of. Where elevator guide rails have to be lubricated by someone riding on top of the car, painting the lubricant on with a brush, the hazard involved makes the job one to be avoided when possible. This, along with the disagreeable nature of the work, makes the guide rails likely to be neglected. When the lubricating is done by hand, the car must be taken out of service. These and many other objections to hand lubrication have led to a wide use of automatic guide-rail lubricators.

If the lubricators are placed in the penthouse with the rest of the elevator machinery, the mechanic can easily give them attention during the regular inspections. The lubricators being in a convenient place, the guide-rail lubrication is insured the same consideration that the rest of the equipment receives. The master guide-rail lubricator developed by Albert Johnson, Victoria Building, New York City, is designed to reduce this operation to a minimum. As shown in the figure, only one lubricant reservoir is required for the four guide rails of one elevator.

Oil is fed from the reservoir by capillary action of wicks *W* that dip into the oil and pass into conveyor tubes that lead to a U-shaped element *E* fastened near the top end of each guide rail. These elements have three wicks, which distribute the oil evenly to the three sides of the rail.

To maintain a constant oil feed from the reservoir to the guide rails, the capillary elements are mounted on a float *F*, which rises and falls in the reservoir with the oil level. The wicks *W* lead into tubes *T* which are supported on the float. These tubes telescope into tubes *T'*, with a clearance that allows a free movement of the float. Since the float maintains practically a constant length of wick in the oil at all levels of the lubricant, the capillary action will be constant and the feed uniform.

The rate of feed to each guide rail is adjusted by lowering or raising tube *T*, which is held in its supporting bracket by a setscrew. This adjustment is necessary, as the car rails will require more oil than the counterweight rails and some installations require more oil than others, even where apparently operating under the same conditions. Then, in the winter months if the temperature of the penthouse is low, the wicks will need to be lowered in order to feed the same amount of oil to the rails as in the summer months.



Phantom view of master guide-rail lubricator

On a new machine the guide rails will require considerably more oil than after they have been in operation for a few weeks. New rails are generally rusty and will absorb oil, and it may be necessary to swab oil on the rails by hand once or twice until the absorption stops.

The reservoir of the lubricator has a capacity of about one gallon of oil, which should be of a light quality such as used in motor bearings. For a twenty-story building this quantity is sufficient for about four months' operation.

Bending Copper Tubing

By R. C. Martin

IN THE near future I expect to have the job of bending some copper tubing for electrical work and wish to know which is the best way to do the work so that it will not buckle or open at the seams.

It may be that some of *Power's* readers have had experience with this class of work and will pass it along for the benefit of others and myself.

INTERNAL COMBUSTION ENGINES

Criticism of Oil Engine Bearings

By R. HILDERBRAND
Diesel Engineer, Fulton Iron Works Company

IT IS claimed that bearings should be redesigned. The method of pouring babbitt is declared faulty. The author eliminates the bearing shell, casting the babbitt direct.

THE loads on the bearings of all oil engines, particularly the wristpin and crankpin bearings, are comparatively high, and it is not an uncommon occurrence that they are a cause of operating difficulties. In some instances the babbitt of the bearings cracks, in other instances the bearings run hot. The general tendency today is to increase the rotary speed of the engines and to reduce their weight, which naturally makes the operating conditions of the bearings more severe.

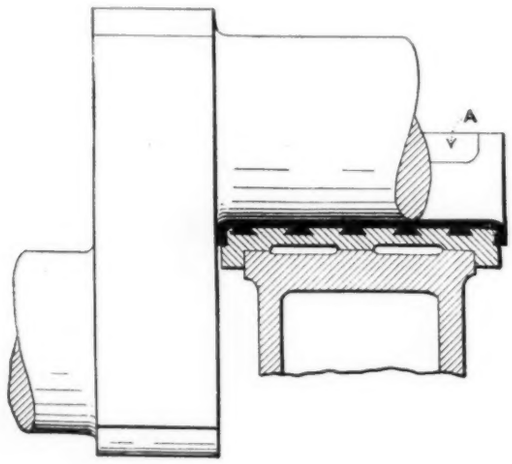


Fig. 1—Type of bearing criticized

That a bearing should be well aligned and properly adjusted is obvious. That nothing but suitable lubricants, copiously applied, should be used and that water, dust and grit should be kept out of the lubricating oil, need hardly to be mentioned. It is well understood by the operating engineer that he should attend to the bearings properly, otherwise difficulties, even with the best designed bearings, will be unavoidable.

The bearing material for oil engines is generally a tin-antimony-copper composition known as Diesel babbitt. This material, if properly applied, will stand a high load per square inch without cracking. It also is suitable for high rubbing speeds. Babbitt is universally used for main bearings and crankpin boxes and, in the majority of cases, for wristpin boxes.

However, some manufacturers use a high-grade bronze for the wristpin boxes. While bronze is a material that is excellently adapted for high bearing pressures, it is not well suited for high rubbing speeds, because it has a high coefficient of heat expansion. In wristpin bearings of oil engines, the load is high and the rubbing speed is low, and that accounts for the good results obtained with bronze wristpin boxes. However, there is a danger in using bronze for this purpose, because the wristpin is located in a place where the temperature is high. In case this bearing overheats, for one reason or another, the bronze grips the pin. This may not only completely ruin the pin and its box, but it may cause seizing and even sticking of the piston. This means ruin to the piston and liner. For this reason most manufacturers prefer babbitt, which, in case the bearing should run hot, will melt out without doing so much damage as would a bronze box.

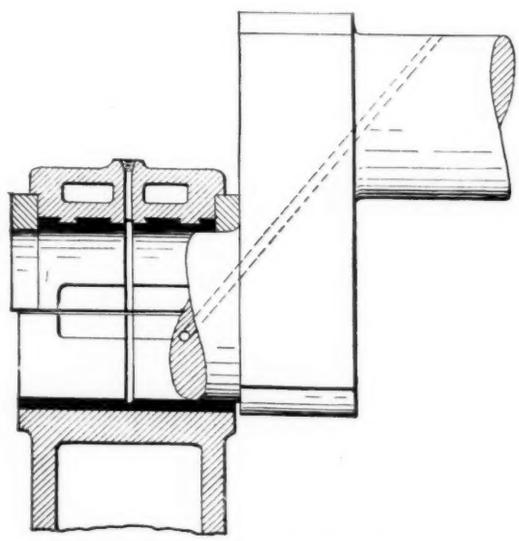


Fig. 2—A cast-in babbitt bearing

Babbitt should be applied so that it does not crack

INTERNAL COMBUSTION *Engines*

under the load to which it is subjected. Being a brittle material, it is sure to crack if not supported over its entire surface. Using cast-iron main bearing shells with dovetailed grooves, similar to Fig. 1, it will be very hard —in fact nearly impossible—to secure a uniform contact between the babbitt and its shell. There will be air caught in the dovetailed grooves while the babbitt is being poured, and the latter will not unite with the cast

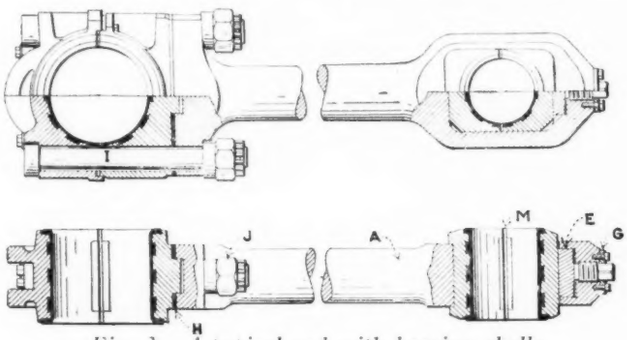


Fig. 3—A typical rod with bearing shells

iron. This will result in the babbitt not being uniformly supported.

Furthermore, even if the shell is carefully heated before the babbitt is poured, the shell will cool off at a rate different from that of the babbitt, causing stresses which may lead to future cracks. Peening the babbitt does not remedy matters; it does not remove the air trapped in the dovetails, nor does it cause the babbitt to stick to the shell. It adds, on the other hand, objectionable stresses to the babbitt. Opinions may differ, but the writer is of the opinion that babbitt should not be peened.

If the shell is made of cast steel or bronze, carefully tinned before the babbitt is poured, the babbitt will stick to the shell and will be much better supported than when the shell is made of cast iron. However, the babbitt, no matter how carefully it is poured into the shell, will always be under stresses because it is anchored to its shell by dovetails and thus it is prevented from free contraction on cooling and from free expansion when it heats up during operation.

Therefore, no matter how time-honored the method of pouring babbitt in dovetailed shells may be, and notwithstanding the fact that this method of securing babbitt to the shells is used the world over, the writer considers it objectionable. A great step in the right direction is the method of centrifugally casting babbitt in tinned shells having smooth surfaces and no dovetails. This will prevent trapping of air between the shell and babbitt and will give a 100 per cent contact between both. Centrifugally cast babbitt has given success where other types have failed.

Even with babbitt centrifugally cast into lined shells there remains one objection—the babbitt cannot expand freely as it warms up in service, for it is tinned to its shell, which has a different coefficient of expansion.

The logical thing to do, is to eliminate the subshell altogether and to lay a loose babbitt shell in the bedplate. The babbitt is then free to expand, and it will have a nearly perfect contact with its supporting surface. Such a main bearing with a loose babbitt lower shell and with the babbitt cast into the cap is shown in Fig. 2. The pouring of the babbitt into the caps and holding it there by dovetails is justified, as the load on the cap is very small, while the load in the lower half shell is high. The shells are cast and machined as full shells and then sawcut into halves. Two caps are clamped and bored together after they have been babbitted. The length of shell equals the length of the journal minus its two fillets. The end faces of the bearing in the bedplate are finished to equal the length of the shell, which is thus supported over its entire surface. The end faces of the bearing caps are not machined. The cap shown acts as the thrust bearing and has both its end faces machined to accommodate horseshoe thrust rings. The left-hand side of Fig. 2 shows a bearing with thrust rings. These rings can be made of babbitt or bronze and can be shimmed up when worn. The cap prevents the lower shell from rotating, and four studs and two heavy dowel pins hold the cap in place. Nothing is required to prevent the lower bearing shell from shifting longitudinally as experience has shown that these shells do not shift.

The design shown in Fig. 2 is not only a good manufacturing proposition, but the results obtained in the field are exceedingly gratifying. It will be admitted that a comparatively thin babbitt shell is somewhat frail and should be handled carefully. However, after it is placed into the bedplate and put to service, it is nearly inde-

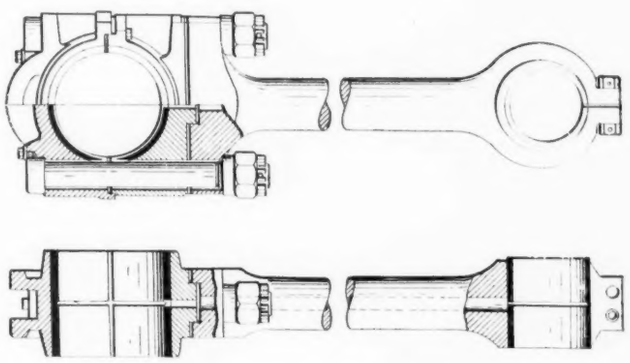


Fig. 4—A connecting rod of the new design

structible. Cracking of the babbitt does not occur; in fact, it cannot crack in actual service. The heat is much better carried away than when it had to run through a subshell, thus the bearings run cooler than do the customary bearings. The removing of the lower babbitt shell is easy, as it will never rust and stick to the bedplate, which iron subshells are likely to do.

Loose babbitt shells are recommended not only for the main bearings, but also for the connecting rods of oil engines.

The connecting rod shown in Fig. 3 has shells made of steel casting, carefully tinned and babbitted. With con-

INTERNAL COMBUSTION *Engines*

necting rods of this design it was not uncommon to find that the babbitt cracked and even broke out after a relatively short service. On the other hand, the connecting rod shown in Fig. 4 has proved in every case far superior to the one in Fig. 3. The upper and lower babbitt bearings are loose shells, being prevented from rotating by shims. The object of splitting the upper connecting rod end is to permit the babbitt shell to be pushed into the rod without difficulty. It is easy and comparatively cheap to replace the loose babbitt shells

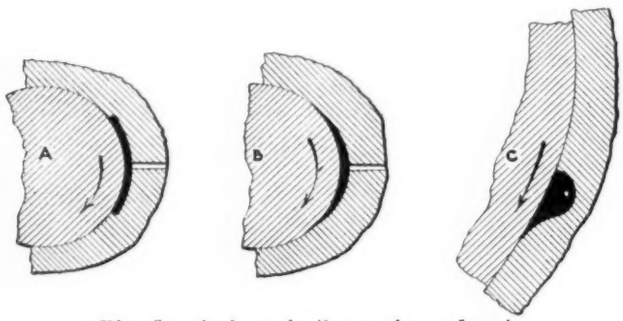


Fig. 5—Action of oil entering a bearing

in case they need it. Here it may be said that these loose babbitt shells, provided the workmanship is fairly good, will never crack and that the wear of the babbitt is much less than with the design shown in Fig. 3. While the wristpin boxes of the latter design need readjustment about twice a year, loose babbitt bushings of the design shown in Fig. 4 have run two years without any excessive wear.

It is the writer's opinion that, while the quality of the babbitt is an important factor, the method of applying it to the bearing is of still greater importance if cracking of the babbitt is to be avoided.

A bearing may heat without cracking. This may be caused by an unsuited or broken-down lubricant. However, there may be cases where the design of the bearing is such that the heat caused by friction in the bearing cannot be readily dissipated into the surrounding air. Higher rotary speeds and lighter engine weights compel the designer to place the working cylinders closer together and to use thick, short journals and crankpins. Thus the bearing surfaces are cut down and in addition their rubbing speed is increased, which makes it more difficult to keep the bearing cool. To dissipate the heat from the bearings, subshells and air spaces between the subshells and bedplates should be avoided, as both are a hindrance to the passage of the heat from the babbitt through the bedplate into the air. Effective lubricating oil coolers and higher pressures in the force-feed lubricating system will help keep the bearing cool.

The oil grooves have a vital influence on the lubrication and running temperatures of a bearing. An oil film must be maintained between the journal and the shell to prevent metallic contact of these parts. As the shaft rotates, the oil inside of the bearing also rotates with a speed less than the shaft speed. Thus oil must be fed continuously to the place below the journals where the pressure exists. The oil will feed from the pockets or reliefs *A* at the sides of the bearing as indicated in Fig. 1. These pockets should have no sharp edges such as are shown at *A* in Fig. 5, for such edges tend to scrape the lubricant from the shaft, but they should run out in wedge-like manner, as shown at *B*, so that the oil is drawn and wedged below the journals and shell. Here it may be said that all oil grooves, if they are used at all, should have their leading sides well rounded, as in Fig. 5 at *C*; otherwise the oil will not readily be fed and be carried along by the rotating shaft.

Cross grooves similar to those shown in Fig. 6 at *A* should be avoided. They not only reduce the bearing surfaces, but also permit the oil film fed by the side pockets of the bearing to escape into the cross grooves, the oil film being under pressure. Thus cross grooves have a tendency to break the oil film.

All that is necessary in the way of oil grooves are the side reliefs shown in Fig. 1. These reliefs may be milled in or they may be scraped, as their depth need only be a few thousandths of an inch.

The lubricant is generally applied to the bearing by a force-feed system. The oil enters the bearing in most of the cases at the top of the bearing, as this makes the most accessible pipe connection. A circular groove is frequently provided to lead the oil from the place of entrance to the reliefs of the bearing, as shown in Fig. 6 at *B*. This is a satisfactory design, although it causes a considerable splashing of oil inside of the crankcase because too much oil escapes from the upper main bearing half, as nearly all the bearing clearance is in the upper bearing half, the pressure being downward.

The splashing of the oil becomes objectionable with high-speed engines and short connecting rods, for too

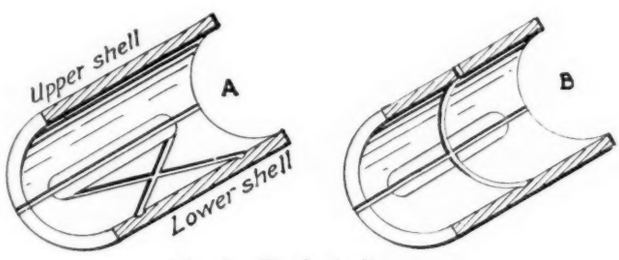


Fig. 6—Typical oil grooves

much oil is thrown onto the liner. This over-lubricates the pistons, fouls the piston rings and results in excessive lubricating oil consumption. For this reason the lubricant in high-speed engines should be introduced on the pressure side; that is, the lower side of the main bearings as shown in Fig. 7*A*. A short circular groove reaching not quite to the side is sufficient to feed the oil to these reliefs or oil pockets. If the circular groove is cut so that it reaches these reliefs and if these reliefs are deeper than a few thousandths of an inch, then even this design causes an undesirable oil splashing and a high lubricating oil consumption.

The connecting-rod bearings may have oil grooves as shown in Fig. 6*B*; that is, side reliefs and circular oil

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grooves. In case of high-speed engines, complete circular grooves in the connecting-rod bearings, as shown in Fig. 6*B*, may cause too great an oil splashing. It will then be necessary to make the oil grooving for the wristpin box as shown at *A* in Fig. 7 and the grooving for the crankpin box as shown at *B*. This provides in the connecting-rod boxes the oil grooving only in those bearing halves where the pressure exists.

The pressure of the force-feed lubricating system should be not higher than necessary to force the lubricant

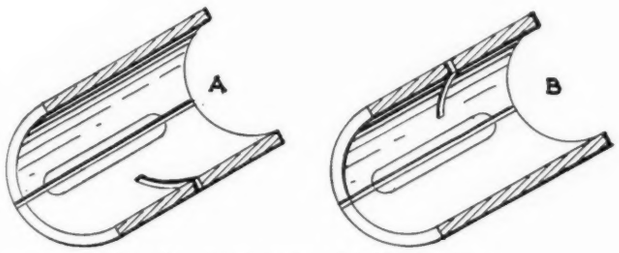


Fig. 7—High-speed bearing grooves

up to the wristpin boxes by means of drilling through the crank and the connecting rods. Unnecessarily high pressures in the force-feed system increase the oil splashing in the crankcase. The pressure in the force-feed system with grooves as shown in Fig. 6*B* can be lower than with grooves shown in Fig. 7. This is explained by the fact that the oil hole drilled through the crankshaft, communicates continuously with the circular grooves in the main bearing and crankpin bearing if the circular oil grooves are complete circles. However, if the circular oil grooves reach only 90 to 120 deg. around, the drilling through the crankshaft feeds oil only intermittently, that is, 25 to 30 per cent of the time.

Fiat Obtains 2,000 Horsepower from a Single-Cylinder Diesel

THAT oil engines of even 20,000-hp. unit capacity are well within the range of probability is evidenced by the 2,000-hp. single-cylinder engine developed by Fiat Stabilimento Grandi Motori, of Turin, Italy.

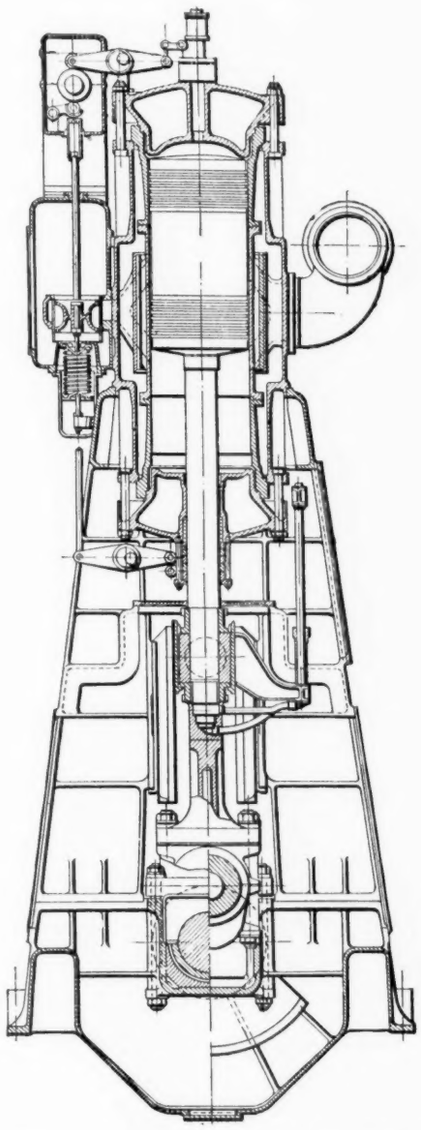
This engine was built some 18 months ago and since then has been listed quite extensively in the experimental department of the works.

The output of 2,000 hp. was obtained at 150 r.p.m. and at 125-r.p.m. 1,500 hp. was obtained. The principal dimensions are given in the table:

Approximate over-all height from underside of baseplate, ft.	29½
Approximate over-all width, ft.	11½
Cylinder bore, in.	33 7/8
Stroke, in.	39½
Piston speed, ft. per min.	990
Full load output, brake horsepower	2,000
Designed speed at full load, r.p.m.	150
Mean effective pressure (brake)	78.4
Mean effective pressure (indicated)	105
Mechanical efficiency, per cent	75
Fuel consumption, lb. per b.hp.-hr.	0.41

A sectional view of the engine is shown in the illustration. The bedplates, cylinder jackets and framing are all made of cast steel. As a consequence through tension bolts between the cylinder head and bedplates are dispensed with.

The cylinder liner is made in four pieces. The upper and lower parts are flange-bolted to their respective



Cross-section of Fiat 2,000-hp. Diesel

inner segments, which are interlaced at the centrally placed scavenging and exhaust ports. It will be seen from the illustration that there is a set of each kind of ports for both the top and the bottom cylinders. The scavenging air is controlled by a cam-operated piston valve, which prevents undue loss of air through the open discharge ports and also prevents flare-back. Air injection is employed, and only one fuel valve is provided for the upper end of the cylinder, while the bottom end has two valves placed in the longitudinal plane.

Plant Inspection and Maintenance Records

IN A plant where the advantages of first-class operating equipment is appreciated, it will be found that the inspection and maintenance are performed in accordance with a definite schedule and that accurate records are kept of each operation.

Unfortunately, inspection scheduling and record keeping are not given the attention that they should be given, and as a result the plant is burdened with frequent failures and heavy maintenance expense.

The cost of maintaining a definite schedule will usually

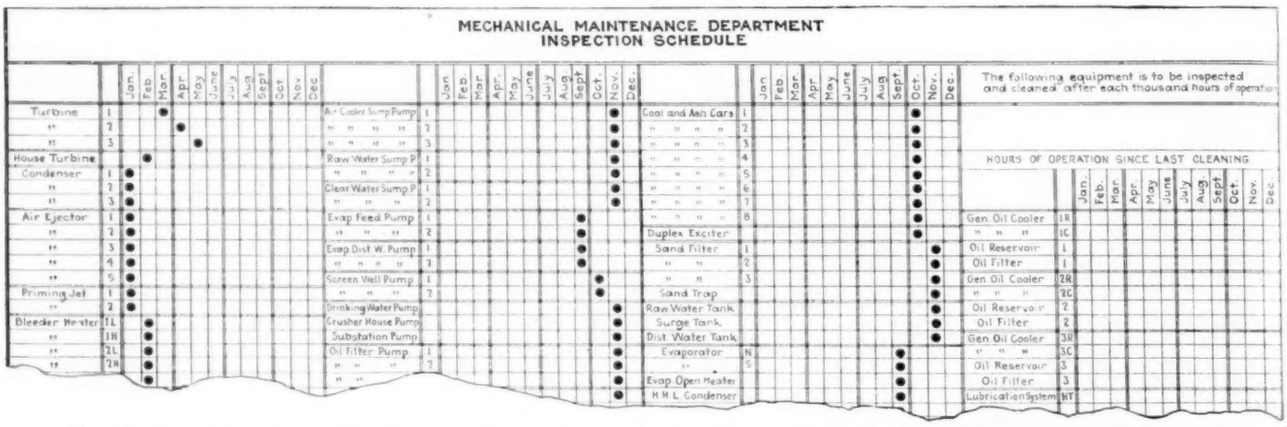


Fig. 1—Part of the mechanical maintenance department's new inspection schedule as used in the Dresser Station of the Indiana Electric Corporation

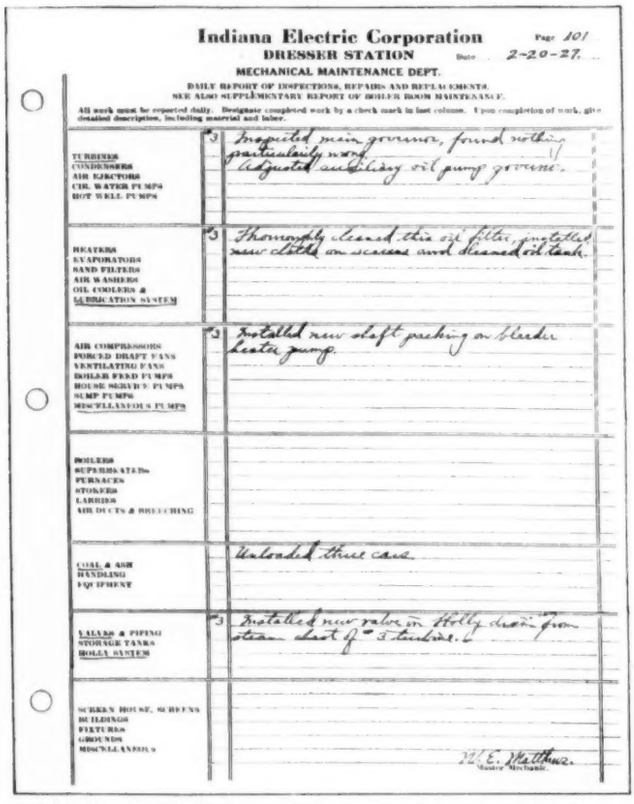


Fig. 2—A typical record sheet used by the mechanical department whenever work is performed on any piece of apparatus

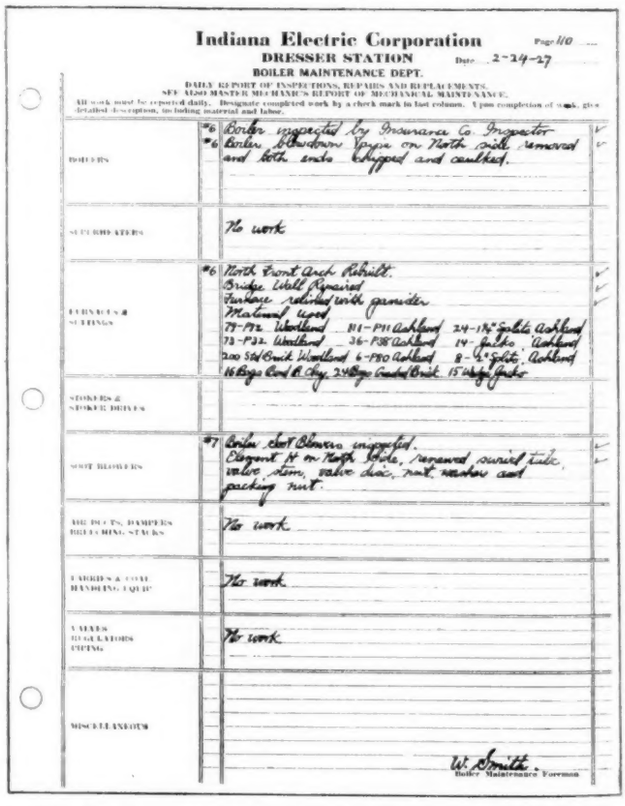

Indiana Electric Corporation
DRESSER STATION
BOILER MAINTENANCE DEPT.
Page 110
Date 2-24-27
DAILY REPORT OF INSPECTIONS, REPAIRS AND REPLACEMENTS.
SEE ALSO MASTER MECHANIC'S REPORT OF MECHANICAL MAINTENANCE.
All work must be reported daily. Designate completed work by a check mark in last column. Upon completion of work, give detailed description, including material and labor.
BOILERS
#6 Boiler inspected by Insurance Co. Inspector
#6 Boiler blowdown pipe on North drill removed and both ends chipped and caulked.
SUPERHEATERS
No work
FURNACES & SETTINGS
#6 North front arch rebuilt.
Bridge Wall Repaired
Furnace relined with granular Material used
79-P32 Woolland 181-P11 Ashland 24-18" Solid Ashland
73-P32 Woolland 36-P18 Ashland 14-9" Arch Ashland
200 Std Brick Woolland 6-P10 Ashland 8-9" Split Ashland
16 Bags Cord & Clay, 24 Bags Castable Brick 15 Bags Finish
STOKERS & STOKER DRIVES
SOOT BLOWERS
#7 Boiler Soot Blowers inspected.
Element H on North blade, removed swivel tube valve stem, valve disc, seat washer and packing nut.
AIR DUCTS, DAMPERS BREECHING, STACKS
No work
LARRIES & COAL HANDLING EQUIP.
No work
VALVES REGULATORS PIPING
No work
MISCELLANEOUS
W. Smith
Boiler Maintenance Foreman

Fig. 3—A sample of the record sheets used by the boiler-maintenance department for records of boiler maintenance

be found to be small as compared with the cost of a failure. When a defect is detected and corrected, the cost of the labor and material will be considerably less than it would be if, through neglect, the defects were permitted to cause a service interruption.

The Indiana Electric Corporation, Terre Haute, consider systematic inspection schedules and accurate maintenance records of such importance that they have given considerable thought to the preparation of a system that would produce the maximum continuity of service and a minimum of maintenance expense. This system was

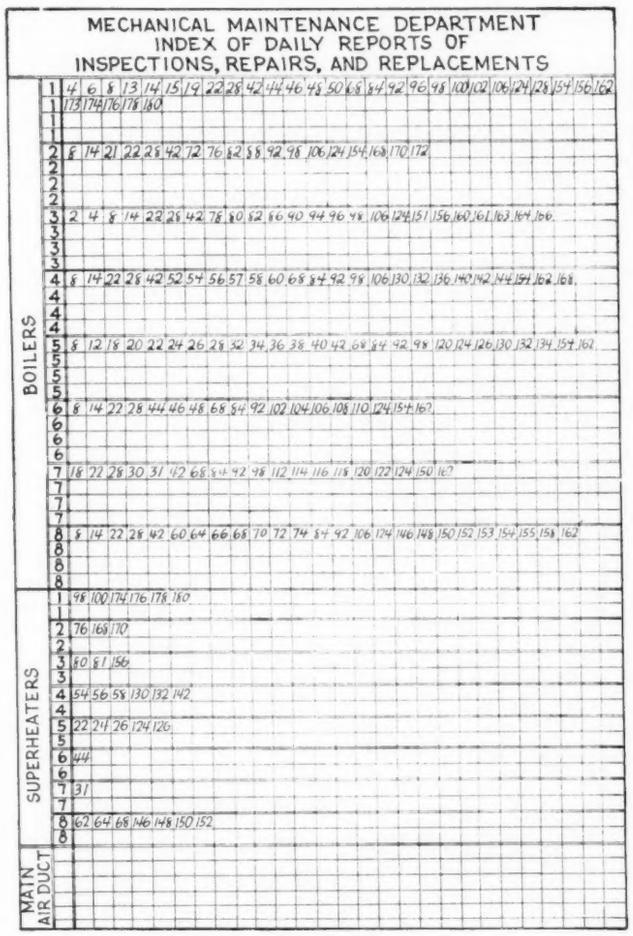


Fig. 4—Method of recording the daily maintenance reports of the various departments of the Dresser Station

adopted when the Dresser Station was first put into commercial operation. It was arranged so that an inspection and maintenance program would be performed on a definite time basis, and predicted three years in advance to a day when each piece of apparatus would be out of service for its inspection and repair. In some cases the system called for the checking of more than forty items in a single inspection, and some equipment was scheduled to be out of service at least 10 per cent of the time. As an illustration, it was required that all oil had to be changed, shafts and bearings checked for alignment on a periodic basis, regardless of how smooth or how cool they were running or the actual hours of service.

The system was tried out, but was found impracticable owing to its complicated construction. After repeated attempts to correct the form, it was finally abandoned and a less complicated system devised.

An entirely new inspection form was made up, and each major piece of apparatus that could be placed on a regular inspection schedule was included. The inspections were arranged to harmonize with the operating conditions, so that the danger of causing a serious service interruption would be decreased to a minimum.

The form of the schedule adopted is shown in Fig. 1. The solid circle indicates the month during which the annual inspection is to be made, but the method of proceeding with the inspection details is left to the judgment of the master mechanic, because he is held accountable for the inspection and maintenance of the apparatus. He keeps in close touch with the chief operating engineer throughout the entire inspection and maintenance period, and when they agree that a piece of apparatus has been put in good operating condition, a cross is marked over the circle corresponding to the apparatus under repair.

Daily Record Sheets Kept

Daily record forms were developed to provide for a permanent record of the work performed and the material used for each repair job. Typical samples of these record sheets are shown in Figs. 2 and 3. These forms are divided into a number of sections, each representing a rather broad equipment classification. The master mechanic and the boiler maintenance foreman use these forms to submit a daily report of the work performed and the material used by their respective departments for any piece of equipment worked upon. These signed records are turned into the office daily, where they are numbered consecutively, filed in loose-leaf binders and indexed item for item. A sample index sheet is shown in Fig. 4.

This system forms a perpetual classified history of all maintenance work, and is taken care of with a minimum of clerical work. If at any time it is desired to review the history of any piece of apparatus, it is only necessary to look up that item in the index and consult the pages of the original work report referred to.

The classification of the accounting department's accounts is so broad that the maintenance cost cannot be figured for each individual piece of apparatus. These data are secured by the direct maintenance expense supplementary records which include material and labor as compiled by the efficiency department monthly. All labor costs are taken from the daily time slips, and the cost of the material is summarized from the storeroom requisitions.

Maintenance costs of boilers, superheaters, stokers and furnaces are reduced to a common basis of cost per ton of coal burned for each month, and cumulative records are kept from the first of the year.

This system has proved satisfactory and has provided a means for keeping accurate detailed maintenance records and the performance of inspections on a systematic basis.

Excessive Calking of Boiler Seams with a flat-ended tool, for beating down the edge of the lap to form a thin calking edge, may impair the tightness of rivets, and excessive driving of the thin edge beneath the upper plate injures the texture of the material and may cause creasing or cutting into the lower plate sufficient to result in injury.

EDITORIALS

F. R. LOW, *Editor*

New Centrifugal Pump Theory

AT a recent meeting of the American Society of Civil Engineers Professor Sherzer, of the University of Michigan, pointed out what appeared to be errors in the derivation of the fundamental equations expressing the action of centrifugal pumps.

Professor Sherzer was, however, not satisfied with merely pointing out an error in present-day pump theory, but developed a practical method for predetermining pump characteristics, which he applied to the design of a new type of pump, the particular feature of which is the absence of volute or spiral casing.

Several sizes of this pump were built and tested both at the University of Michigan and by the manufacturer. The results agreed closely with the design curves and showed efficiencies equaling those obtained by present-day pump manufacturers.

Whether one agrees or disagrees with the theory and ideas advanced by Professor Sherzer, it must be admitted that this type of research that starts with theory and carries through to a practical conclusion is greatly to be commended. Others engaged in research will do well to consider that the value of their work to industry depends largely on the ability to apply their results to a practical design application.

The Engineer in Civic Life

CITY, state and federal governments now and then undertake an enterprise that calls for specialized guidance. In the engineering field it may be flood control, water-power development, road-traffic direction, smoke abatement or zoning.

Such tasks are usually attacked in a wave of enthusiasm arising from some catastrophe or from strong popular clamor. The public welfare is held to be in jeopardy, and prompt and effective action is demanded.

Not uncommonly, the first step is the appointment of a commission of experts, to serve without compensation, perhaps with the help of a small staff of underpaid assistants of greater or less competence. The experts give the work scant attention, and the staff sometimes lacks the punch to put the job through.

The next step, in all too many instances, is the simple petering out of the effort with the failure of warm enthusiasm to keep pace with the daily drag of the job. Presently, everybody is happy again. The task remains undone and may be forgotten. If it is remembered, the wise heads will recount how former efforts have failed and promote the opinion that it can never be done.

What futility!

Perhaps the prime weakness of this time-honored method lies in the lack of amateur experts. Most men of specialized ability make their living by the application of their talents. If an industrial enterprise enlisted their services, it would unquestionably be for adequate compensation. Just because the public, through the government, requires the same services, why should they be rendered gratis?

Acting on a temporary committee to map out a program is one thing; working on a long-lived commission to see the job through is quite another. And yet no engineer of ability is free from the importunate begging of his time and talent to do the very work by which alone he earns his living. That many do give full measure of devoted service is high credit to their public spirit and a sad reflection on the sense of fairness of the community they serve.

In an emergency any man of character will give his all, even to risking his life, to save those whose lives or property are in peril; but when there is no emergency, when there is merely some problem of public concern to be attacked, it is hardly fair to ask a man to divert his special ability, his whole stock in trade, from the earning of his own livelihood to the free service of the public in the doing of a big job—the very job to which he legitimately looks for his most substantial means of support.

If the engineer is employed by a public-spirited firm that is asked to release part or all of his time for civic service, the request is unfair to the firm, albeit the firm may be well able to afford the expense. If he is an independent consulting engineer, as is often the case, the request is unfair to him, and it is more than likely that he can ill afford the consequent inroad upon his time.

The public is greedy of free services. Often, when they are granted, they prove to be worth about what they cost. No man can be expected to devote his best efforts to complimentary tasks of appreciable magnitude. Free services may result in a half-done job.

This is one aspect of the engineer in civic life. A big task is worth full-time, fully paid expert execution. The laborer is worthy of his hire.

Over-all Efficiency Should Be the Objective

IN THE operation of hydro-electric plants the water passing through the units may be divided into two parts—that which is used when the wheels are in operation, and the quantity that leaks through the gates when the machines are shut down. Frequently, the latter is not given the attention that its importance warrants, particularly if a unit is shut down for a considerable part of the time.

If a unit operates at an average load of seventy-five per cent of its rating for twelve hours a day, and when shut down ten per cent of full-load water leaks through its gates, this leakage will amount to over thirteen per cent of the water taken by the machine over a twenty-four hour period. If, while the machine is in operation, its efficiency is eighty-five per cent, when the leakage water is included, the over-all efficiency drops to about seventy-five per cent.

The latter efficiency is what tells the story of how the plant is operated and what is being obtained from the available water. Where the total water available at the plant is utilized (which is generally the case except in flood periods), any that runs to waste represents kilowatt-hours that must be produced by some other source, frequently by burning coal. Therefore it is highly important that the water leaking through a unit when shut down, which does not show on the load records, should be taken into consideration. When this is done, some of the operators that boast of high efficiencies for their machines, may not be quite so proud of their operating records.

If the over-all efficiency of the installation is taken care of, the efficiency of the individual machines also forms part of the plan. Watching the efficiency of the machine and at the same time neglecting the leakage that may be going on while the units are shut down, may be the cause of low over-all efficiency, even if that of the machine, when in operation, is high.

Beware of Low Voltage Circuit Hazards

THERE is in general among workmen a realization of the dangers involved when working around high-voltage circuits, which has done much to prevent accidents on these lines. On the other hand, the hazards associated with voltages within the range of from one hundred to two hundred volts are not appreciated as they should be. It is on these circuits that many of the fatal accidents occur.

One of the dangerous features in handling low-voltage circuits is that they are not always hazardous. In a dry clean place a workman may handle a live one-hundred-and-ten-volt circuit with little discomfort. Contact with a circuit at this voltage, when in a wet confined place, may be extremely dangerous. One of these places is within a steam boiler. To guard against this danger, a metal-covered extension cord should be used on the lamp and this metal covering attached to the lamp socket and effectively grounded. Better still, a fifteen- or twenty-volt lighting outfit should be provided to use in such places.

Boilers are not the only dangerous places, as shown by a recent report of a fatal accident occurring to a workman who went into an empty water tank to clean it out. While in the tank he came in contact with a live part of the extension light that he took into the tank with him, and was killed. Even in a wooden tank, when its bottom is covered with a wet sediment and connected to ground through the outflow pipe, the hazard of a low-voltage electric shock may be almost equal to that in a boiler.

Statistics show that the major number of fatal accidents on electric circuits occur on those operating at five hundred volts and less. The fact that these circuits are more common than the high-voltage lines and that workmen come into closer proximity with them, may be one reason for the higher fatality, but a disregard by workmen for the hazard involved is also an important cause. If those working with electric circuits had at all times realized that anything above one hundred volts is hazardous to life, many of the fatal accidents that have occurred would have been prevented. Contempt for low-voltage circuits will not save a life if contact is made with it under certain conditions.

What You Have Been Looking For

Power's Prize Winners Will Be Announced and the Three Prize Articles Will Be in Next Week's Issue

THESE articles were chosen, from forty-four submitted, by three judges representing different branches of power-plant engineering. Each article tells how large savings were made by improved power-plant design and operation.

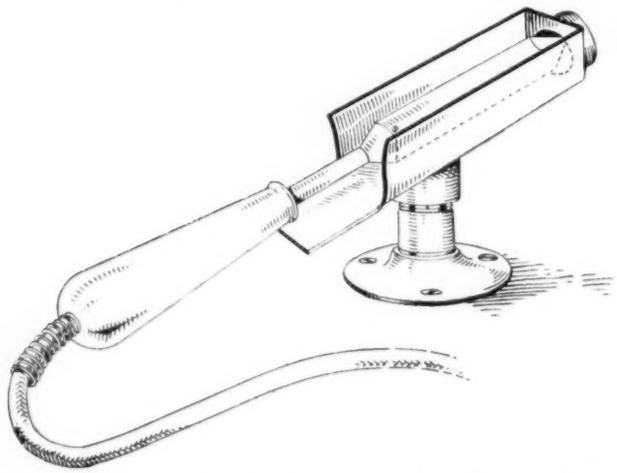
IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Practical Holder for Electric Soldering Iron

THE electric soldering iron holder, shown in the illustration, so well filled a need on our shop workbench, I believe many other engineers would like to make a similar one.

The body is made from a discarded 1½-in. L-type conduit fitting, by sawing down each corner of one end



Soldering iron holder made from discarded conduit

and turning the end back as shown and the sides outward at the back corners slightly.

The 1½x4-in. pipe nipple and standard floor flange used were also taken from the scrap pile.

The holder not only eliminates a fire hazard from a carelessly placed hot iron, but the iron will heat quicker and hold its heat longer since it is shielded from free air circulation.

R. M. ROTHGEB.

Raleigh, N. C.

A Simple Boring Machine

SIMPLE appliances can sometimes be made to do the work usually performed by elaborate machines as the following description and sketches will show.

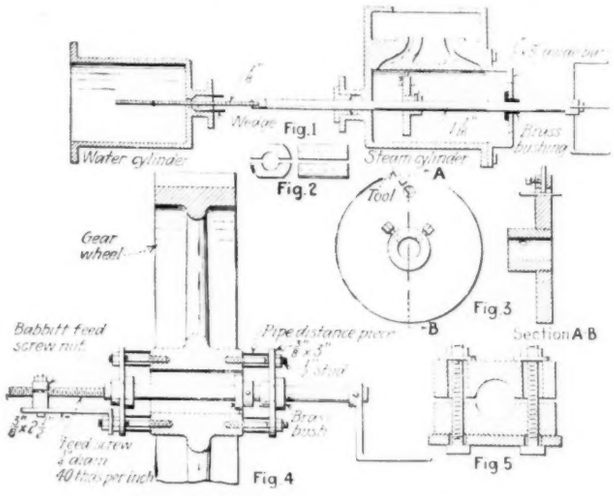
Fig. 1 shows how the steam end of a water pump was rebored. The cylinder was 10 in. in diameter and the boring bar, a piece of cold-rolled shaft, $1\frac{7}{16}$ in. in diameter and about 3 ft. long. In the center of one end of the boring bar a piece of $\frac{7}{8}$-in. mild steel rod 18 in. long was screwed tightly. This rod was threaded its whole length with 40 threads to the inch, to serve as the feed screw.

The feed-screw nut consisted of a piece of babbitt turned to fit the packing box of the water cylinder. It was bored $\frac{7}{8}$ in. diameter and then split lengthwise (see Fig. 2), and on the backs of both halves flats were formed to allow the use of wedges to clamp the halves of the feed nut onto the feed screw; they also prevented the feed nut from turning.

The feed screw formed its own thread in the babbitt nut, the threads being well lubricated and the wedges tightened occasionally until the thread was fully formed. The toolholder was made from a cast-iron blank flange fitted with a mild steel hub tightly screwed in and pinned, then bored to fit the boring bar.

The toolholder hub was provided with two ½-in. setscrews for securing it to the boring bar, and the rim was drilled to receive the boring tool, which was secured by a setscrew. Another hole was drilled to allow the use of a wedge to feed the tool Fig. 3. The outer end of the bar was fitted with a four-armed crank which was turned by two men sitting opposite each other.

Before the boring was begun the steam cylinder was



Assembly and details of boring bar

about ¼ in. larger in the center than at the ends and it took three cuts to bring the bore true and give it a good finish.

I was once sent to change the gear wheels of a mine hoisting engine, and when I tried to put on the new gear wheel, I found the bore to be $\frac{1}{32}$ in. smaller in diameter than the shaft. The wheel was about 7 ft. in diameter, and it was twenty miles to the nearest machine shop. So I decided to make the boring rig shown in Fig. 4.

The gear-wheel hub was drilled and tapped on both sides to receive two ½-in. studs for securing the boring-

bar guide plates, which were made of $\frac{3}{8}$x3-in. mild steel bars fitted with brass bushings screwed in with a pipe thread, and bored to fit the boring bar. The bar was a piece of cold-rolled shaft $1\frac{5}{16}$ in. in diameter fitted at one end with a crank and the other with a feed screw.

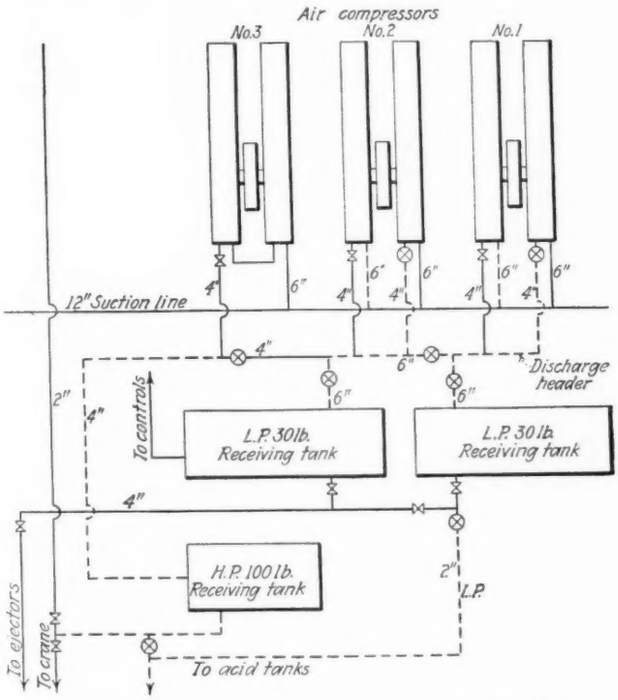
Fig. 5 is a section through the babbitt feed nut showing how the bottom half is clamped fast to the support while the top half is free to be clamped to the feed screw, which forms its own thread in the feed nut.

I have many times used this type of boring bar for boring out cast-iron pulleys, flywheels and crankpin holes. Instead of a plain crank I sometimes use a large valve wheel fitted with a nicely formed free crank handle. On certain classes of work the boring bar can be driven by a slow-motion air motor. E. J. JORDAN.

Long Beach, Calif.

Increasing the Compressed Air Supply By Changing the Pressure

WE WERE always having complaints for more air, although our compressors were operating at full capacity continuously. The equipment consisted of three cross-compound two-stage compressors, giving air at about 100 lb. pressure, with two connected receivers.



Arrangement of pipe lines and receivers for high- and low-pressure air supply

A large amount of the air could have been used at lower pressure, especially since the pressure was seldom above 70 lb. owing to the draining of the air as fast as produced.

To take care of the low-pressure demand, it was decided to put low-pressure cylinders on two of the compressors in place of the high, making each a twin, single-stage compressor instead of two-stage. The pressure from these two machines would then be 30 lb. in place of the previous 70 lb. obtained.

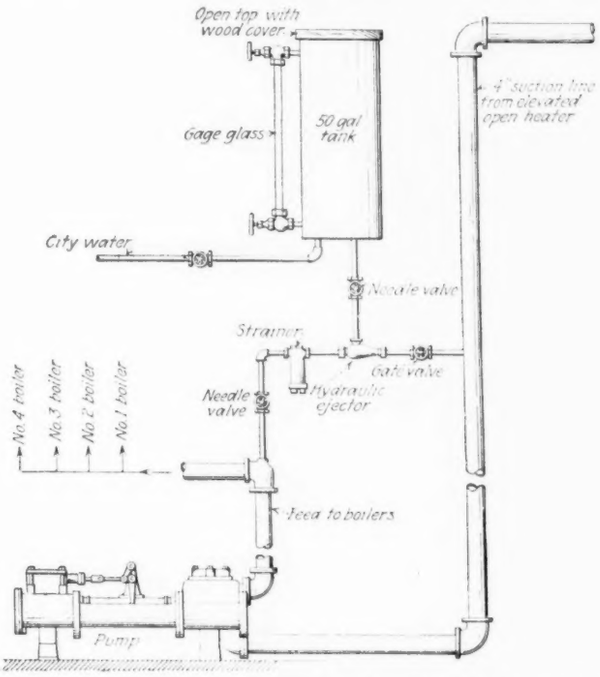
The third compressor was left on the two-stage arrangements to supply the 100 lb. demand. The air lines were rearranged to give two separate supply lines as shown in the illustration.

This arrangement fulfilled all expectations, giving an abundance of air for all purposes. L. G. JONES.

Philadelphia, Pa.

How the Feeding of Boiler Compound Was Made Uniform

INVESTIGATIONS of the variation in hardness of water in our boilers, by tests made just before each blowdown, showed exceedingly erratic feeding of compound. To remedy this condition the arrangement shown in the sketch was made up at small cost and has worked



Hydraulic ejector feeds compound uniformly to suction of feed pump

well in practice. In use, the proper amount of compound is measured out in a bucket, and after the city water has been turned on, it is dumped in the tank. The incoming water agitates the contents and makes up a batch of 50 gallons of uniform solution.

The solution is then fed into the pump suction line (which is under about 10 ft. head) through a small hydraulic ejector which utilizes water from the pressure side of the pump for its operation.

Needle valves in the pressure line and tank line allow ready adjustment, and it is easy to secure a uniform rate of compound feed over a period of four to five hours. This insures each boiler getting compound in proportion to its load, and tests show that the samples of water taken from different boilers are very close to one another in hardness.

It was found necessary to insert the small strainer in the pressure water line to prevent particles of loose scale clogging the small throat of the ejector. It is also good practice, when pouring the compound into the tank, to use a fine-mesh sieve. R. W. DODSON.

East St. Louis, Ill.

COMMENTS *from* READERS

Engineer Disagrees with "What Do You Know" on How to Cut Gage Glasses

REFERRING to the answer given to question No. 9 in the Aug. 23 issue, "How can gage-glasses be cut"? I have found by experience that it is not necessary to file a notch all around the tube, as the answer states. In fact, far better results will be had if the glass is notched only on one side, the notch being $\frac{3}{16}$ to $\frac{1}{4}$ in. long. The breaking is done by grasping the glass firmly with both hands, placing the thumbs opposite the notch, and, when bent, the glass will give a clean, straight break at the notch. I admit that I have had no occasion to try this method on Pyrex glass, but it has never failed on other high-grade glass. G. C. W. GOLEM.

Branford, Conn.

* * * *

Will Incorrect Distribution of Air on an Underfeed Stoker Cause Grates to Burn Out?

I SHOULD like to have some information through the columns of *Power* as to the proper operation of underfeed stokers, particularly with regard to admitting the right quantity of air through certain parts of the grate.

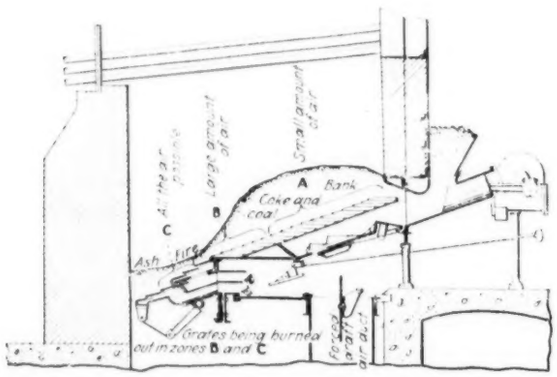


Fig. 1—Plan of air distribution used by fireman No. 1

At the present time there is a difference of opinion as to the cause for the grates burning out in one part of the stoker.

One fireman in our plant, whom we will call No. 1, arranges the damper to admit air to the fuel bed about as shown in Fig. 1, in which a comparatively small quantity is admitted through the thick part of the bed and the maximum amount through the thin section just ahead of the dump grate.

The other fireman, or No. 2, arranges the dampers to admit the air about as shown in Fig. 2, in which the bulk of the air is passed through the thick part of the bed and a lesser amount toward the rear of the stoker.

The power-plant engineer claims that firemen No. 1 is right because he was instructed by the stoker manufacturer's representative. However, I do not agree with

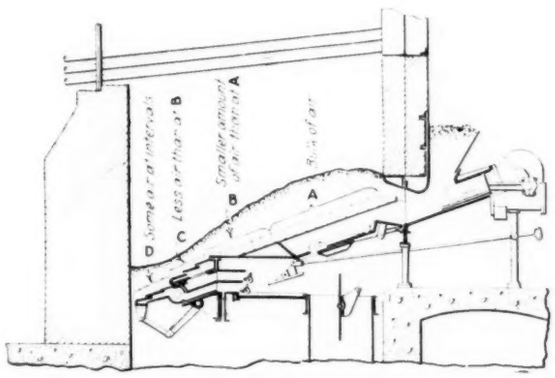


Fig. 2—Plan of air distribution used by fireman No. 2

him, and maintain that the method shown by Fig. 2 is the right one.

It occurred to me that a few comments from some reader of *Power* who is experienced in the operation of underfeed stokers would be helpful not only to us, but to many other readers and particularly to young men entering the combustion field. J. J. CROFT.

Corning, N. Y.

* * * *

Collecting Hot Flue Gas

THE item on page 277 of the Aug. 23 issue on the use of tubes other than iron for collecting hot flue gas above 750 deg. F., is interesting. There can be no doubt of the facts as stated in this item. These facts would also seem to hold in the case of analyzing exhaust gases from an internal-combustion engine. There have been many gas-engine tests reported of which the performance was based on the exhaust-gas analyses. From the facts presented it would appear that such analyses would give fallacious results, even though proper care was taken to use sampling tubes that would have no effect on the exhaust gases. The passing of the exhaust gases over the exhaust valve, the temperature of which is in excess of 750 deg. F., would affect their composition considerably.

It is a well-known fact that exhaust valves are subject to a good deal of oxidation, much of it no doubt being due to the breaking down of the carbon dioxide in the products of combustion. The resultant gas sample is therefore changed from the actual products of com-

bustion. This seems to be true, as published results of such analyses show a high carbon-monoxide content, usually in the neighborhood of 10 per cent, even though precautions were taken in proper mixing or carburetion. Owing to the inherent design of our internal-combustion engines it would seem impossible to collect a true representative sample of exhaust gases. Such analyses would therefore have little practical value in indicating the performance of the engine as to what is actually taking place in the combustion chamber.

State College, Pa. A. J. NICHOLS.

* * * *

Is Positive Pressure in the Combustion Chamber Desirable?

IN REFERENCE to the article entitled "Is Positive Pressure in the Combustion Chamber Desirable?" by L. W. Hayward in the Aug. 30 issue, I believe that Mr. Hayward has brought out a wonderful possibility. He has shown that the trend is toward the operation of a furnace with a positive pressure.

The one thing that I do not understand is, "Why does Mr. Hayward show that his thoughts as to furnaces are progressive, but as to regulators non-progressive? He showed this by the statement, "There would be no need of cumbersome dampers in the breechings or regulators to hold the furnace draft at a definite amount by correlating the speed of the induced-draft fan to that of the forced-draft fan or by controlling the dampers." By this assertion he tends to give the view that dampers and regulators are a necessary evil.

Regarding the use of a regulator on a boiler of the combustion control type, the regulator keeps the draft in the combustion chamber at a predetermined value. The reason for controlling the draft is to obtain efficiency in the combustion of the fuel, which means that each pound of coal burned has to have the right amount of air. This will apply whether the present method of burning coal is used or the method mentioned by Mr. Hayward.

Assuming that we should advance to the point where the type of furnace mentioned should become standard, why should not we also advance accordingly in the regulation of combustion? The main reason that combustion regulators were first brought out was because we could not depend on the human element.

I do not want to create the impression that I am against progression, but I wish to bring out the point that to be progressive you must bear in mind that while you are progressive in the advancement of your own science, the other fellow is progressing also.

Chicago, Ill. J. J. NEVILLE.

* * * *

Method for Testing Condenser Leakage

HAVING read the abstract in the Aug. 9 issue of A. E. Grunert's article on "Method for Testing Condenser Leakage," I would like to mention a few practical pointers that should be observed when using this method of determining condenser leakage.

The electrical-resistance method for obtaining the relative resistance of condensate samples drawn from steam condensers is an accurate and dependable one if the following conditions are closely observed:

1. The time element has an effect on the conductivity of the sample after being drawn from the condenser. This is caused by the sample absorbing varying quantities of air, depending on the length of time between drawing the sample and the final test for relative conductivity. The best plan is to draw the sample and immediately close the container, making an airtight joint. When ready to make the test, use the same time period for testing each sample of water in order that the absorption of air will be the same in each case.

2. The container used in drawing the sample and the container used in the testing apparatus must be clean and washed out with the sample to be tested. Do not touch the interior of either container with the fingers after washing. Wash the cork or cover of the sample container with the same water as the sample to be tested and be careful to obtain a perfectly clean sample free from contamination.

3. All samples should be of the same temperature when tested; varying temperatures give varying resistance.

The electric-conductivity method has been in common use for the last ten years in detecting condenser leakage in large condensers, and when properly used a pinhole leak in a tube or a small seepage through tube packing can be readily detected.

W. R. PENDER, Engineering Department,
Ancon, Canal Zone. Electric Bond & Share Co.

* * * *

Practical Application of Clearance Pockets

IN *POWER* of July 12, 1927, an article appeared entitled, "Why Clearance Pockets on Ammonia Compressors?" by G. Grow. In his well-written article he states that engineers cannot design an ammonia compressor that will perform efficiently under a variable refrigerating load, if hooked up with a constant-speed motor, and for that reason clearance pockets have been resorted to. Further on he says that when a 9 per cent clearance pocket is opened, the compressor will pump less gas and operate with less power per stroke, but will use more power per ton of refrigeration. That sounds curious, but I will have to admit that it is all correct as far as it goes, but do not let us overlook the fact that Mr. Grow is operating this compressor on his desk.

The sketch of the fixed clearance cylinders are well gotten up and correct, and I will even go so far as to admit the clearance-pocket cylinder and diagram are correct on his desk, but if a 9 per cent clearance pocket were opened when operating in an ice plant, the diagram would look like a different animal. This simply shows that Mr. Grow's compressor education in the office at his desk may be extensive, but his plant operating experience is very limited.

He speaks of opening a 9 per cent clearance pocket, and I take for granted that he thinks a 9 per cent clearance pocket is small enough, but the smallest, I am sure, in plants where a little gray matter is used to operate the plant, is not over 4 per cent. His reasoning on clearance pockets seems to be on a par with that of the man who had been told that a currycomb was half the feed, and so bought two and tried to do without feed for his horses.

If a compressor driven by a constant-speed motor is operated on a 20-lb. suction pressure and the water and ammonia temperatures drop 5 deg., the brine temperature

will drop also. The only thing he can do is to curtail the flow of liquid at the expansion valve, thereby lowering his suction pressure, and the compressor will be operating at an increase in power cost per ton and he will not get the benefit of the temperature drop of water and ammonia. The suction pressure may drop to such an extent that water jackets or direct expansion to the cylinder is resorted to, to keep from injuring the valves.

If the compressor is equipped with clearance pockets and the pressure drops from 20 to 19 lb., increasing the clearance would cause the pressure to run back to 20 lb. Then by curtailing the liquid feed at the expansion valve to hold 20 lb. suction pressure, the compressor will be operating again at the same power consumption per ton and make the same amount of ice and get the benefit of the temperature drop between the water and ammonia, and using that much less power per ton. The same method can be used to curtail ice output.

I do not want to be understood to mean that a compressor will not use more power per ton of ice when operating with clearance pockets than it does with clearance pockets closed, for it must use more, but it is so little that it is hardly worth while mentioning. We know there are cylinder heat losses and there must be a difference in the actual and in the indicated power consumptions with the pockets open or closed, but as stated before, it is so small it would be hard to define.

No man can lay out an indicator diagram of a compressor with 9 per cent clearance on his desk and tell us what effect it will have in an ice plant. He can tell us what will go on in the cylinder the moment the pocket is opened, but I doubt if the diagram would show what would go on in the next stroke. If an operating engineer that has had no experience with clearance pockets will take a diagram from a cylinder equipped with clearance pockets just before the pocket is opened and keep on taking them for 15 minutes, I am sure he will have food for thought for a year.

Compressor power per ton is governed by the difference between the ammonia temperature at the receiver and in the tank coil of the freezing tank. When these temperatures come together at 32 deg., we do not need a compressor to make ice, but if we want to hasten the process we must use a compressor and we pay in compressor power for the difference.

In a 200-ton ice plant with 75-deg. condenser water, 80-deg. ammonia and 70-deg. can water, a coil temperature of 5.5 deg., and the suction-gas delivered to the compressor cylinder at that temperature, we pay expensively for compressor power. A great many plants are operated that way. At the same time we can operate this plant to make the equivalent of 45 tons of ice at a coil temperature of 26 deg. and a suction pressure of 40 lb. and save 35 per cent of compressor power making this 45 tons of ice. But in order to do this, we must have a compressor equipped with the proper kind and size of clearance pocket, if the compressor is hooked to a constant-speed motor.

When the plant that I am operating was designed, the engineers had not only capacity in view, but in addition a plant that would make from 32 to 200 tons at an almost constant power cost.

With two compressor units, all clearance pockets closed, and can water at 40 deg., 200 tons per day can be produced at 42 kw.-hr. per ton. With all clearance pockets open, 162 tons are produced at 42 kw.-hr. per ton; after shutting down one unit and opening all clearance pockets on one unit, 75 tons can be produced at 38 kw.-hr. and 32 tons per day will take 54 kw.-hr. This performance was first accomplished under the able coaching of the engineers who designed the plant and the co-operation of the crew, and shows what can be accomplished with a constant-speed compressor with clearance pockets.

I am sure that what actuated Mr. Grow to bring out his article on clearance pockets was to enlighten operating engineers and plant owners. He did not believe in hiding his light under a bushel, for his article is absolutely correct as far as he went, but I could not resist the impulse to carry it a little further.

New York City. J. R. BERND, SR.

Answers to What Do You Know

The questions are on page 586.

Ans. 1—Wash it with a 10-per-cent solution of hydrochloric acid.

Ans. 2—No. The maximum velocity occurs when the pressure ratio is a maximum. Owing, however, to the difference in the weight per cu.ft. of air at various exit pressures, the maximum weight discharged per second occurs before the maximum velocity is reached.

Ans. 3—Yes, provided it is not so large as to excessively overload the other motors in operation. The motors in service act as phase changers to convert the single-phase power into polyphase for starting the motor.

Ans. 4—Near the sections that are over the sheaves or drum when the car is at the landings. This is caused by short sections of the cables being wound on and off the sheaves or drum due to the operator.

Ans. 5—Charles M. Schwab.

Ans. 6—In order to permit the easy removal of the interior feed line in case it becomes stopped up with scale.

Ans. 7—At 3,200 lb. water and steam have the same density. Consequently, a steam bubble, when formed, has the same volume as had the water from which it was formed. There is, then, no need of large disengaging surfaces, and boiler drums, which are hard to construct for high pressure, can be dispensed with, to the increased safety and decreased cost of the boiler.

Ans. 8—The governor cannot anticipate load changes. The increased withdrawal of steam leaves less steam for expansion in the lower stages, and momentarily the power developed by the turbine is insufficient to carry the load on the machine. The speed continues to drop until the governor opens the throttle sufficiently to pass enough steam to enable the turbine to develop the necessary torque at that speed. The turbine continues to operate at this new lower speed until pressure and load conditions change.

Ans. 9—Sweet, Armstrong, Rites, Shepherd.

Ans. 10—No. With the steam pump the water handled would be the average of 10,000 gal. per hour, which would entail 2,875,000 ft.-lb. of work, or 1.5 hp., by the pump. If the pump uses 100 lb. of steam per horsepower per hour, a total of 150 lb. of steam is used. In case of the motor-driven unit the pump must handle the maximum capacity of 15,000 lb., and when boiler demand is lighter the excess must be bypassed. The pump load is then 4,312500 ft.-lb., which at 50 per cent efficiency calls for 4 hp., or 200 lb. of steam.

New and Improved EQUIPMENT

Yarway Boiler Water Column with "Sesure" Inclined Water Gage

THE boiler water column and the inclined water gage illustrated are a recent development of the Yarnall-Waring Co., Philadelphia, Pa. The column is available in three types to cover a complete pressure range up to 650 lb. It is furnished with a high- and low-water alarm as standard equipment.

The inclined water gage, which carries the trade name "Sesure," is also standard equipment. The gage has been purposely designed as an independent unit, however, so it can be furnished for any make of water column now in service or used to improve visibility over that possible through the use of the usual vertical water gage on overhead liquid containers both in and out of the power house.

The column body is forged from a solid steel billet. The outside diameter is that of standard 6-in. pipe, and the wall thickness is approximately $\frac{3}{4}$ in. The forging has been made of ample length to provide for settlement space below the lower water connection. The blowdown line is threaded into the bottom of the column forging and, when so specified, is fitted with the Yarway junior seatless blowdown valve as shown. The top of the column is fitted with a pair of steel flanges that are forged from the solid. The lower flange is threaded in place, and the upper flange is machined to make a captured joint against the column wall.

For pressures to include 250 lb., the boiler connections are threaded. Above this pressure flanged fittings, forged from the solid, are shoulder-threaded into the column and are then arc-welded.

The general arrangement of the high- and low-water alarm is shown in Fig. 2, and that portion of the alarm mechanism from the balance levers upward is shown disassembled in Fig. 3, to show the construction in detail. Cast-iron weights operate the alarm on the displacement principle to obviate any possible danger of failure to hollow floats. These weights are suspended from opposite ends of both levers, so that their vertical movement imparts a rocking motion to the levers without any off center strain. This motion is, in turn, communicated to the valve stem to open and close the alarm valve. The suspending rods, lever pins and the lever fulcrum are of stainless steel, while the levers, the valve stem and the valve sleeve are of hydraulic bronze. The valve sleeve *A* (see Fig. 3) which supports the mechanism is screwed into the upper column flange, so this complete mechanism can be lifted from the column as a unit. The sleeve projects above the top flange to bring the removable valve pin and seat outside of the column assembly for ready inspection.

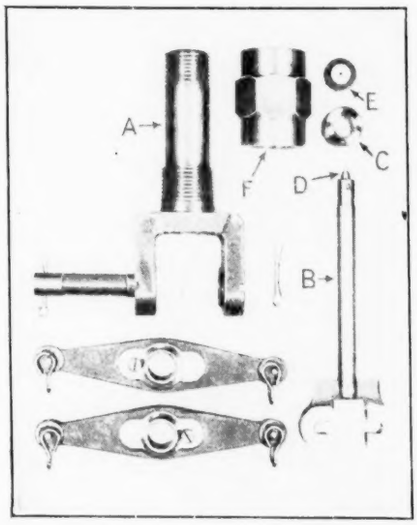


Fig. 3—Disassembled view of alarm-valve operating mechanism

The valve stem *B* is guided by a bronze bushing *C* which rests on top of the main sleeve. The stem carries a hardened nickel-steel pin *D* that has been ground to fit into the valve disk *E* which is set on top of, and guided in the bushing. Both the pin and the disk, which are reversible, are held in place by means of the cap *F* that screws down over the sleeve. It is only necessary to remove this cap to inspect or renew the valve disk and pin.

An alarm whistle, furnished as standard equipment, screws into the valve cap. The company is prepared to furnish this cap with a side outlet, as illustrated, to which a mercoid switch will be attached when so specified. This type of switch is fully insulated from the column. It is intended to be connected to warning lights on the firing floor level, on the boiler-control panel or in the engineer's office, or to recording instruments conveniently located to preserve a record of water-level fluctuations over a period of time.

The water gage is fitted to the column with screwed connections for pressures up to 250 lb. and with flanged fittings above this point. All parts of the gage are made of hydraulic bronze and, when

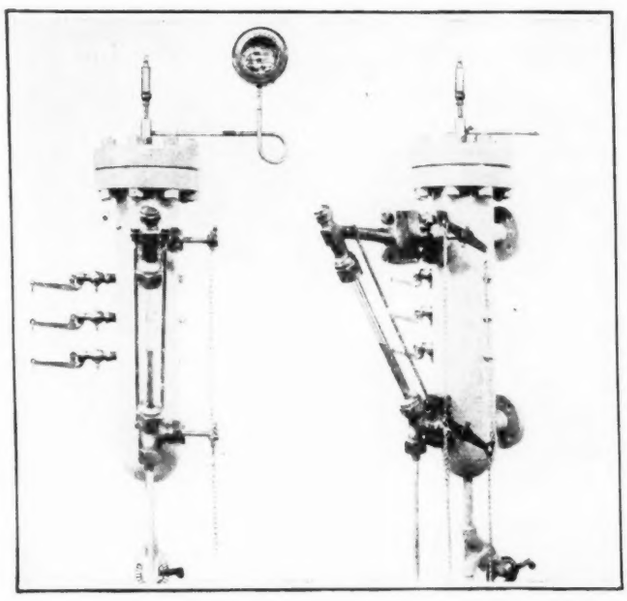


Fig. 1 — Front and side views of water column with inclined gage-glass, high- and low-water alarm and mercoid switch

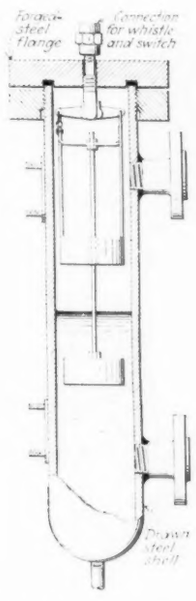


Fig. 2—Method of suspending valve-operating weights in water column

flanged, are secured to the column with special heat-treated studs.

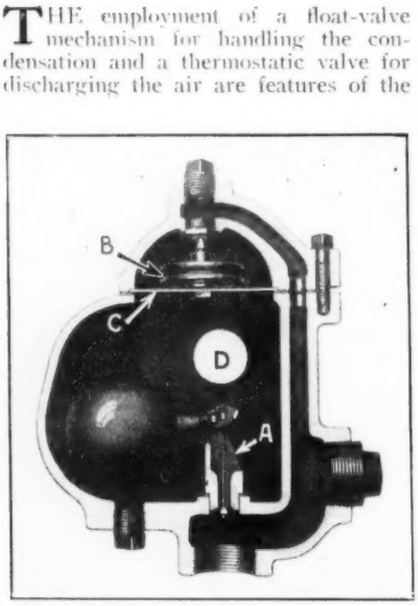
The type of gage that is designed for the heavy pressures is constructed, as illustrated, to give a slight incline downward in the upper leg toward the column. This incline, together with a bronze baffle built into the fitting above the glass, leads back to the column, any condensation that would otherwise run into and score the steam portion of the glass. The gage is regularly provided with the tube glass as shown for the high pressures, but when it is so specified the prismatic glass will be supplied.

An important feature of the whole assembly is that the glass and column lie in line with each other and are not offset.

In accordance with standard practice the column is drilled on both sides for the try-cocks, so they can be assembled for either hand. Standard try-cocks of accepted make are furnished in accordance with the customers' desires.

Webster Drip Trap Size 026

THE employment of a float-valve mechanism for handling the condensation and a thermostatic valve for discharging the air are features of the



Drip trap with float valve for water and thermostatic valve for air

drip trap brought out recently by Warren Webster & Co., Camden, N. J.

The trap is designed for a maximum working pressure of 10 lb. and is suitable for draining the condensation and air from heating systems, unit heaters, hot-blast coils, etc. The float and valve assembly *A* is removable as a unit. It is held in place by two monel metal studs with brass nuts, not shown. An outward-opening spherical-seated valve is used with a simple linkage connection to the float.

The thermostatic element is essentially the same as that used in the Webster series 78 thermostatic trap, described in the August 16 issue. The expansion member *B* is fastened to the disk *C*, which is held in place between the body and cover of the trap.

Inlet openings $1\frac{1}{4}$ in. in diameter are provided on both sides of the trap as at *D*, so that right- and left-hand installation can be accommodated with the same model. Outlet openings on both the end and bottom provide for the discharge of the water or for both water and air. An opening is provided in the cover of the trap so that the air may be discharged separately to a dry return if desired. The trap can be mounted in the pipe line without other support, the total weight being only 18 pounds.

Stephens-Adamson "Simplex" Belt Conveyor Carrier

THE illustrations show a new type of belt conveyor carrier recently brought out by the Stephens-Adamson Manufacturing Co., Aurora, Ill. The new carrier, which is known as the "Simplex," is being made for belts rang-

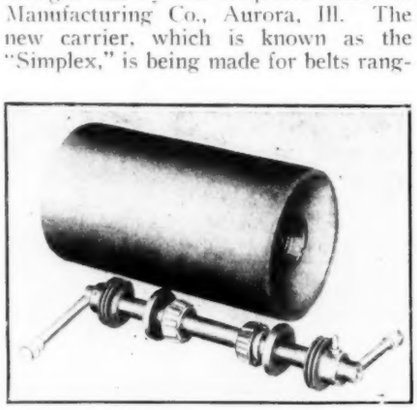


Fig. 1—Detail of roller with bearings, labyrinth washer and multiple groove grease seal

ing in width from 12 to 60 in. The carrier proper consists of three rollers in line, the troughing rollers being mounted at a 20-deg. angle in order to increase the capacity of the belt. The carriers are mounted on a heavy steel angle section base, which is self-cleaning.

The rollers are self-contained units, made of steel tubing and furnished with drawn steel end plates. Each roller is equipped with two tapered roller bearings, the method of mounting the bearings being as follows: The cones, or lower races, are pressed onto the roller shaft and located by a washer. The cups are pressed into a steel tube which forms the roller axle, and are located by shoulders in the tube. The bearings are protected from dust by a combined labyrinth washer and multiple groove grease seal.

The rollers proper are mounted on malleable iron stands, which have large, flaring caps to assist in preventing the entrance of dirt into the bearings. The stands that support the outer ends of the troughing rollers are made to swing out to facilitate removal of the outer roller and permit access to the center roller from either side.

Lubrication of the rollers is of the high-pressure grease type, each roller shaft being equipped with two pressure fittings. The shaft has drilled passages which connect the fittings with the interior of the tube in which the bearings are mounted, the latter serving as a reservoir for the lubricant.

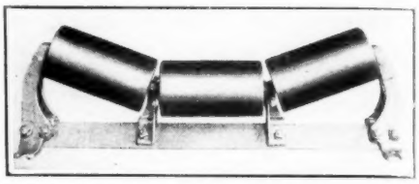


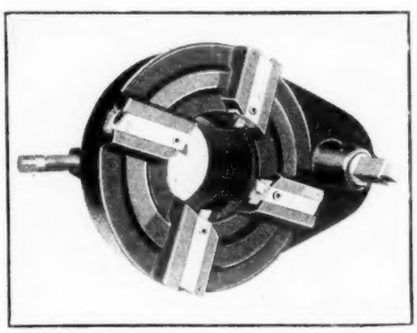
Fig. 2—Assembly of belt-conveyor carrier

All the parts of the carriers, such as bearings, shafts, rollers, brackets, and complete roller assemblies, are mutually interchangeable for belts of the same size.

"Toledo" Automatic Pipe Cutter

THE automatic pipe cutter for cutting 2- to 4-in. pipe recently brought out by the Toledo Pipe Threading Machine Co. is illustrated.

The machine is designed to give a straight square-end cut with no inside burr and to leave the outside edge chamfered to facilitate the starting of the die. The knives are fed automatically, requiring no attention on the part of the operator. A single hand wheel sets them



New automatic pipe cutter for 2 to 4 in. sizes

for cutting or the quick return of the knives after the pipe is cut off. One jaw only is used to center the tool on the pipe and hold it in place.

The cutter is operated either with the regular ratchet handle furnished with the "TOLEDO" No. 2 or No. 25 threading tools or with a "TOLEDO" power drive. The weight of the cutter is 65 pounds.

St. Louis Fuels Meeting a Marked Success

Seven hundred engineers meet to discuss basic problems of fuel supply, low-temperature carbonization, combustion, refractories, modern boiler design and smoke abatement

FROM the viewpoint of attendance, quality and diversity of papers and enthusiastic participation in the discussion the first national fuels meeting held under the auspices of the Fuels Division of the American Society of Mechanical Engineers, in co-operation with the St. Louis section, from Oct. 10 to 13, must be classed as a decided success. It would appear that the campaign inaugurated by this group for the better and more efficient use of fuels and the reduction of the smoke evil is well launched. A definite impetus to fuel research, an awakened interest in fuel problems and better performance from the general exchange of information are some of the things to be anticipated as the aftermath of this meeting.

Increased Use of Fuel

At the opening session, with John Van Brunt, chairman of the Fuels Division, presiding, short addresses of welcome were extended by John Lyle Harrington, past-president, and J. H. Gross, representing the Mayor of St. Louis. An address on "Fuels, Past and Prospective," by Prof. S. W. Parr, was a fitting introduction to a meeting devoted to this general subject. As a background from which to realize the progress that had been made in the last 100 years, brief reference was made to the history of fuels. Of the outstanding features attention was called to the increase in volume of coal production in this country from 11 million tons in 1826 to 600 million tons 100 years later, representing respectively 1 and 5 tons per capita; the trend toward the use of smoke-making fuels; the advance in efficiencies, and the development of the smoke evil. In the steam-making plant, the speaker said, the production of great volumes of smoke was an unnecessary extravagance but unavoidable in household or apartment heating where raw coal was fed into the furnace. For the future Professor Parr was optimistic, some of the helpful features being the growth in public intelligence, the advance in scientific investigation and the great activity in fuel research the world over.

Discussion brought out advances in the making of water gas and producer gas and the drawbacks imparted to underwater combustion by the auxiliaries, such as the large amount of power required to compress 14 lb. of air for every pound of coal and the enormous air pumps needed to remove this same air from the condenser. The conclusion reached was that any system introducing additional equipment increased the losses, and unless these losses could be made up by the recovery of byproducts, the better plan was to stick to the modern boiler and get out of it the best efficiency possible.

American Fuel Resources

Other papers and the discussion follow in brief outline.

O. P. Hood, Chief, Technologic Branch, United States Bureau of Mines, gave a brief picture of American fuel resources in gaseous, liquid and solid form. In 1925 a little over eight cubic miles of natural gas was delivered to consumers. This had the potential heating value of 35,000,000 to 40,000,000 tons of coal, or something less than a month's production of bituminous coal. A most careful inventory, as of Jan. 1, 1922, placed the oil in the ground of the United States at about nine billion barrels.

Notwithstanding the enormous amounts of coal in the ground, the author pointed out that the reserves of coal available at the present economic level was a much smaller quantity, that the fuel used per capita had increased from 0.85 ton per year in 1870 to 5.15 tons in 1925, and that the increase was likely to continue for some time.

A valuable contribution that may help to clarify the engineer's conception of the mechanisms involved in the furnace problem was a paper on "Combustion and Heat Transfer," by Prof. R. T. Haslam and H. C. Hottel, research associate, both from the Massachusetts Institute of Technology. The subject matter summarized the present status of knowledge on heat transmission by radiation, including some recent developments in the theory of non-luminous gas radiation and some new ideas on radiation from powdered-coal flames. In the discussion reference was made to the numerous assumptions that were necessary in radiant-heat formulas and to the fact that measurements in practice were little more than one-half of the calculations obtained by formula.

One of the most interesting subjects under discussion was covered by a paper on "Recent Developments in Low-Temperature Coal Carbonization," by Col. H. D. Savage, vice-president of the Combustion Engineering Corporation. He said that the recent developments had been going on so rapidly and surely that this system was now on a practical, mechanical, operating basis. While the design and installation still must be in the hands of those with accurate knowledge, when once installed, the operation is no more exacting or complicated than that of the power plant or the gashouse and may be carried on by the average operating crew.

Interest in this subject was indicated by the prolonged discussion of the paper, turning to the uses for the byproducts, the relative prices of the processed fuel, the relative consumption of gas and electricity during the different seasons of the year and the possibility of mixing the distilled gas with natural gas as the supply of the latter dwindled.

High Cost of Fuel Saving

In a paper on the "High Cost of Fuel Saving," delivered at the industrial session on Tuesday morning, W. Trinks, professor of mechanical engineering at Carnegie Institute of Technology, gave numerous examples in the power plant and in the steel mill to show that under the present economic order it is cheaper in many cases to waste fuel than to save it. To decide whether to replace fuel-wasting equipment by other equipment that would save fuel, the standard method of calculation is based entirely on dollars and cents, or immediate personal gain. Apparently the only way in which fuel may be conserved for future generations is to make it dear artificially.

In the discussion it was remarked that mortgaging the earnings of future generations for possible fuel savings may be undesirable, especially as new fuel sources may develop. The reclamation of waste heat, it was remarked, has not been fully realized, largely because specialists in that field are not consulted enough.

A study to determine the most economical steam pressure for a certain plant was presented. Over a period of ten years, with a capacity use factor of 0.56 and low coal cost, it appeared that a 600-lb. plant would use less coal than

a 350-lb. plant to the extent of one million dollars, but at the expense of two million dollars additional fixed charges.

As a means for saving fuel others spoke of the use of handy centralized controls and appropriate instruments, the need for better trained operators and the advantages of a bonus system, with the final remark that the true yardstick of engineering service to society was dollar efficiency rather than technical or thermal efficiency.

Application of Powdered Coal to Small Boilers

In his paper on the "Application of Powdered Coal to Small Boilers of Industrial Plants," Henry Kreisinger, of the Combustion Engineering Corporation, said that small plants are usually stoker or hand fired, and results are frequently far from satisfactory, with monthly operating efficiencies seldom as high as 70 per cent. The small-plant operator wishes to secure the higher efficiencies and capacities reported for large pulverized-coal plants, but as a rule the small plant cannot gain as much as the large one, although they can appreciably improve their operating efficiency.

The smaller plant is restricted in the choice of equipment, especially as the mills wear and produce coarser coal, and these restrictions are bound up with the basis for financing industrial power plants, which are often required to show nearly double the rates of return that are acceptable to public utilities.

Prof. A. W. Gauger, of the University of North Dakota, in the discussion, reported briefly the results of experiments in pulverizing and burning lignite. His remarks will be presented more fully in a later issue of *Power*. Burning lignite at rates from 14,500 to 17,500 B.t.u. per cu.ft. per hour, he secured efficiencies as good as those common with stokers for dry lignite with high ash-fusion temperature, and better than with stokers for lower-grade lignites.

In efficient steam-plant operation coal selection is probably the most important single factor, because only through proper selection can coal best suited to existing plant equipment be bought. This statement was made by Morgan B. Smith, engineer, General Motors Corporation, in his paper on "Factors Governing the Purchase of Coal." The author outlined the leading factors entering into coal selection, such as a study of the general characteristics of the field or district and the seam where the coal is mined, a careful analysis of the coal itself to obtain the relative content of volatile, ash and sulphur-determination of the burning characteristics, labor costs for conditioning fires and handling ash and many other factors.

In the discussion reference was made to the unfair practice of basing judgment on a large delivery of coal from samples taken from comparatively few cars. Averages from the entire shipment were preferable. The difficulty of uniform sampling led to the suggestion of more general use of automatic samplers to eliminate the human element and to the permissible tolerances in sampling large shipments that are now being worked out by the American Society for Testing Materials.

Stuart M. Phelps, of the Mellon Institute of Industrial Research, in discussing "Properties of Refractories and Their Relation to Conditions in Service," stated that refractories could be used to greater economy if furnace designers and operators were better acquainted with the properties and limitations of the products now available, particularly as radical developments in refractory products were improbable.

Boiler Characteristics

"Characteristics of Modern Boilers" was the subject allotted to E. R. Fish, vice-president of the Heine Boiler Company, who traced the development of boilers from early installations of small capacity to the modern boiler brought into being by the successful introduction of the steam turbine. Methods of construction were compared and the changes brought about by the advent of higher pressures. High rates of combustion making necessary tremendously enlarged furnaces, the introduction of water walls, more general use of economizers and air preheaters and the call for high superheat were some of the things that complicated modern design. All these items and the problems they introduced were given space in the paper.

Situated ten miles from Niagara and operating in conjunction with water power to carry the peaks on an annual load factor ranging from 8 to 15 per cent, is the Charles R. Huntley stand-by steam station of the Buffalo General Electric Company. The recent addition of four 12,500-sq.ft. direct-fired powdered-coal boilers with well-type furnaces, water-cooled walls and 76 per cent economizer surface, and the subsequent results obtained gave the basis for one of the most interesting papers of the meeting. This paper and the prolific discussion that ensued will be presented more fully at a later date.

W. B. Chapman, vice-president of the Chapman Engineering Company, reviewed progress in gas-producer practice. After discussing the development of the gas producer for industrial furnace heating and the relative merits of stoker-fired and pulverized coal, oil, producer and other fuel gases, the author discusses details of producer design. He predicts the use of producer gas for boiler heating, with producers of large capacity designed expressly for this service, with appropriate modifications in boiler design. He cited preliminary experiments in England that indicate possibilities of excellent results.

In a paper of some length on the burning of liquid fuels, principally for power purposes, Ernest H. Peabody, president of the Peabody Engineering Corporation, touched upon a wide variety of topics, beginning with oil production and fuel-oil supply and distribution, including Diesel engine, domestic burner, locomotive and marine requirements, with comment on developments in these fields. Comparison was made of various types of steam and mechanical burners followed by comments on boiler efficiencies, sizes of unit, furnace volumes, preheated air, flame impingement and air- and water-cooled walls.

A paper of special interest to the power-plant field was that by F. H. Daniels, president of the Riley Stoker Corporation, on the "Characteristics of Modern Stokers." The different types were defined and an outline given of the characteristics required, with a summary of how these requirements are met by traveling-grate and multiple-retort underfeed types.

In the discussion the wisdom of adding pulverized-coal firing to a stoker setting was questioned, and the opinion was expressed that it might be better to omit the stoker and use pulverized coal alone. It was stated that in several instances chain-grate stokers pick up load as rapidly as underfeed. High efficiency and low maintenance were claimed for the chain grate. Mention was made of the effect of a variety of fuels on stoker operation and of the expense of shutting down a large boiler for minor stoker repairs.

Air-Preheater Applications

F. M. VanDeventer, Mechanical Engineer with Henry L. Doherty & Co., New York, in his paper on "The Economics of Air-Preheater Applications," outlined the development of the air preheater to reduce the increasing flue-gas loss due to higher steam pressure, higher evaporation rates and the use of regenerative feed heating. Not only has heat been recovered, but combustion has been improved, apparently without greatly increased maintenance.

Vigorous discussion of this paper indicated lively interest in the subject. Much of the discussion concerned details of the author's method of analysis and his basic assumptions. One speaker presented at length the merits of the rotating regenerative type of heater. It was also held that the implication that the economizer is losing its place is not correct, and that it still has a distinct field of service.

T. A. Peebles, Chief Engineer of the Hagan Corporation, read a paper on "Automatic Combustion Control," in which he showed how combustion-control systems have evolved from steam-pressure regulators, and how their superior merits are coming to be appreciated by the engineer. Steam pressure maintained constant to any desired degree and air and fuel quantities are held in proper relation for good combustion.

Several discussors emphasized the importance and value of automatic control, going even further than the author in stressing this point.

NEWS *of the* FIELD

Fourth World Engineering Congress to Meet in Japan, 1929

A testimonial dinner was tendered at the University Club, New York City, on Friday evening, October 7, to Baron C. Shiba, Director of Aeronautical Research Institute of Japan, who is in this country to arrange for United States participation in the Fourth World Engineering Congress to be held in Tokyo during October, 1929.

At the dinner attended by sixty members of various engineering and kindred organizations, mention was made of the favorable attitude of Secretary Herbert Hoover and the Engineering Bureau at Washington toward the undertaking. Elmer A. Sperry, chairman, board of directors Sperry Gyroscope Co., has accepted the chairmanship of the preliminary American Committee of arrangement. Mr. Sperry presided and introduced John W. Lieb, vice-president, New York Edison Co., who acted as toastmaster and introduced the Baron, who said in part:

Urges Rationalization of Industry

"It is needless to say that the human welfare is largely depending upon the activity of engineers and scientists. Now our brother engineers are awakening to their responsibility and the important place they occupy in world affairs. There are a great many important problems needing the collaboration of engineers and scientists in order to contribute to the world's prosperity. Above all, I believe, the study of engineering organization, including economic problems, such as rationalization of industry and industrial agreement, is a matter of great importance.

"Other matters which need the collaboration of engineers throughout the world are the establishment of an internationalization of engineering standards. Standardization of specifications of materials and manufactured articles will improve the manufacture and storing of goods, facilitate transactions and intercourse between different countries, and greatly contribute to the general development of our world industry. Carrying out of the work of internationalization of standards entirely depends upon the intensive collaboration of engineers.

Seeks American Co-operation

"Another subject of great importance, is co-operation in researches. Scientists are already co-operating, and they often meet to exchange their views on their studies; for example, the Third Pan-Pacific Science Congress held in Japan last year. Up to now, engineers have not met as scientists have met in international gathering to discuss their common problems. But I think now there are a great many subjects to be discussed together and needing the collaboration of engineers throughout the world.

"The Japan Society of Engineers, a federation of 14 technical societies, which I have the honor to represent here, has proposed a World Engineering Congress in 1929, and I wish to report progress of plans for holding this Congress in Japan: Our government has agreed to support us in various ways.

Baron C. Shiba

Research by High-Speed Film

"A preparation committee including all the industrial activities and governmental officials, etc., has been established and the first official invitations have been sent abroad through diplomatic channels, and I believe these will reach you in the near future. Much of the success of the Congress will depend upon the co-operation of American engineers. We profoundly hope that a distinguished delegation of American engineers will represent the United States at this Congress."

A resolution of apreciation and acceptance of Japan's official invitation presented through Baron Shiba, and a cordial endorsement of the international movement furthered by Baron Shiba's visit, was read by Mr. Lieb and unanimously adopted by the meeting.

Outlining the possibilities of the high-speed film in research work of many kinds, Baron Shiba lectured on "Research by High Speed Motion Pictures" before the Aeronautic Division of the A.S.M.E. at the Engineering Societies Building the evening of October 10. His talk was illustrated by a film on aeronautic research, some of which was made at the rate of 20,000 photographs a second.

Diesel Engine Topics Listed for Marine Engineers Meeting

Seven papers offering much of interest to marine power engineers are included in the program of the technical sessions of the thirty-fifth general meeting of the Society of Naval Architects and Marine Engineers, which will be held in New York City, Nov. 10-11, at the Engineering Societies Building.

Prior to the general meeting, the council of the Society will meet the afternoon of Friday, November 9. The papers, dealing essentially with boilers and Diesel engines, will be presented the morning of Nov. 11.

"Test of Pulverized Coal as Applied to Scotch Marine Boilers," Carl J. Jefferson, member, Commander Joseph S. Evans, U.S.N., visitor; "Pulverized Coal Tests of a Marine Water Tube Boiler," Thomas B. Stillman, member; "Test of a Two Cycle Double Acting Marine Diesel Engine," Ernest Nibbs and Stephen A. Gardner, members; "Diesel Engines for the Navy," Edward C. Magdeburger, visitor; "The Engines of the U. S. Shipping Board Diesel Conversion Program," Captain Richard D. Gatewood, (C.C.), U.S.N., member; "Modern Trend of the Diesel Engine with Respect to Low Weight per Horsepower, High Revolutions per Minute and High Mean Effective Pressure," Otis D. Treiber, member, and, "Vibration and Engine Balance in Diesel Ships," Professor Frank M. Lewis, member.

Muscle Shoals Again An Issue

Federal operation of the Muscle Shoals water power project, ill fated at the last session of Congress, will have the determined backing during the coming session of a group of Senate and House members. Republican Senators George W. Norris, Nebraska; William E. Borah, Idaho; Robert M. La Follette, Wisconsin, and Gerald P. Nye, North Dakota, with Philip D. Swing, Republican Representative from California, and Clifford Pinchot, former Governor of Pennsylvania, will unite for a definite legislative program.

Plant of 350,000 Hp. Planned by Penn. Water & Power

Another important stage in the development of electrical power along the Atlantic seaboard was under way October 11 when the Pennsylvania Water & Power Co. applied at Harrisburg, Pa., for incorporation papers for two new companies. The announced purpose of the new incorporations is the construction of a 200,000 hp. hydro-electric power plant on the Susquehanna River at Safe Harbor, Pa.

The development lies above the Conowingo plant of the Philadelphia Electric Co. and also above Holtwood Dam of the Pennsylvania Water & Power Co. The fall of the Susquehanna River between Columbia, Pa., and the upper end of the pool formed by the Holtwood Dam is proposed to be utilized.

According to preliminary information the development will have an ultimate capacity of 350,000 hp. and will involve an outlay estimated at $30,000,000. It is estimated that the new project will be able to furnish all the electric energy which can be absorbed by southern and central Pennsylvania, Maryland, District of Columbia, northern Virginia and the southeastern section of West Virginia for some time to come.

Merger in Combination May Result

Following the announcement there was speculation whether the project would ultimately be tied up with the giant Conowingo (Md.) plant of the Philadelphia Electric Co. and through the consolidation of the electric company's interests with those of the United Gas Improvement Co. become a part of the great power chain now visualized for a large part of the Atlantic Coast.

Any immediate interest in the new project was denied by representatives of both the United Gas Improvement Co. and the Philadelphia Electric Co., who declared there was no connection between their corporations and the application made at Harrisburg.

The site of the projected development includes a part of Manor Township in Lancaster County and a part of Chanceford Township in York County. The applications specify as names the Chanceford Water Power Co. and the Safe Harbor Water Power Company.

If the applications are granted, they will be merged, if possible, under the name of the Safe Harbor Water Power Co., and application for a certificate of convenience will then be made to the Public Service Commission of Pennsylvania by that corporation.

New York Power & Light Forms Merging Five

Organization of the New York Power & Light Corp., representing a merger of five utilities operating in eastern New York, was authorized by the Public Service Commission October 11.

The companies consolidated are: Municipal Gas Co. of Albany, Adirondack Power & Light Co., Troy Gas Co., Cohoes Power & Light Co., and the Fulton County Gas & Electric Light Company.

Appointed Chief Engineer of Dry Quenching Equipment

Walter Sennhauser, formerly mechanical engineer for Sulzer Brothers, Ltd., Winterthur, Switzerland, arrived at New York, September 26 to assume his new duties as chief engineer of the Dry Quenching Equipment Corporation.

This company is a new subsidiary of International Combustion Engineering Corp. and was organized to exploit the recently acquired American rights to patents covering the Sulzer System for dry quenching coke.

Walter Sennhauser

Unit for Canada Northern Power Co. Soon Ready

Work is steadily progressing on the erection of the additional unit at the Canada Northern Power Co.'s Quinze River power plant. The plant is located at the Quinze River inlet to Lake Timiskaming, in Northern Ontario. The new unit will generate 20,000 hp. and will bring the total capacity of the plant up to 40,000 hp., and the total production of the different power units of the Canada Northern Power Co. up to 96,500 hp.

Sees No Decline in Power Demand of West

Slowing up in the construction of new hydroelectric projects in the West does not mean any decline in the rate of increasing demand for power, Major Glenn E. Edgerton, the chief engineer of the Federal Power Commission, explains after an extended trip through California, Oregon and Washington.

Continuance of the extraordinary influx of population and the growth of industry and agriculture all indicate that demand will increase rapidly. The decrease in the amount of construction, Major Edgerton believes, is a result of interconnection. This has increased the effectiveness of existing facilities to such an extent that a temporary falling off of construction has resulted.

Two 1,400-Lb. Steam Units for Kansas City Power & Light

Plans for the addition of two complete steam generating units for the Northeast station of the Kansas City Power & Light Co. have been completed, and contracts placed with the Combustion Engineering Corp. for their installation. Each of the units will deliver 250,000 lb. of steam per hour continuously.

The boilers are designed for 1,400 lb. pressure. The contract includes Lopulco unit systems for burning pulverized fuel, water-cooled furnaces, economizers and air preheaters, all manufactured by Combustion Engineering Corporation.

This contract closely follows one awarded to Combustion Engineering Corp. in August for the Grand Avenue station of the Kansas City Power & Light Co., covering three units of 225,000 lb. capacity, complete with stokers and designed to operate at 700 lb. pressure. Forty boilers are now installed at the Grand Avenue station. The three new units are to have a total steaming capacity equal to more than half that of the entire existing plant.

New Power Plant Planned for Russia

Plans are under way for a new power plant in Leningrad, according to the Moscow *Economic Life*, says the Department of Commerce.

One project is to build this station using peat as fuel, with a total capacity of 240,000 kw. and an initial capacity of 120,000 kw., the cost of which is estimated at 37 million rubles, or approximately $18,000,000 par value. The station is to supply current for Leningrad industries and for the October Railroad.

Canadian Paper Uses Fourth of Generated Power

Recent figures published by the Power Branch of the Canadian government show that the pulp and paper industry uses practically a quarter of the power generated in the Dominion.

At the beginning of 1927 there was a turbine installation in the power plants of the country totalling 4,556,266 hp. Since the beginning of the year new generators have been added in both old and new developments, with the result that

today the generative capacity of the water-power plants of the Dominion amounts to some 5,000,000 hp. Of this figure the pulp and paper companies develop some 800,000 hp.

Cascade Power Plans 60,000-Hp. Project in Washington

The Cascade Power Co. of Seattle, Wash., has applied to the Federal Power Commission for a preliminary permit covering a project on the Wenatchee River near Leavenworth, Wash.

It is proposed to build one dam three miles below the outlet of Wenatchee Lake and another dam two miles west of Leavenworth. The power is to be used for public utility purposes. It is planned to store 200,000 acre-feet in the lake. The plan is expected to make available 60,000 hp. of primary capacity.

Westinghouse Generator Unit for Steel Mill

The Youngstown Sheet & Tube Co., Youngstown, Ohio, plans the addition of an 18,000-kw. turbine-generator unit. The new unit will be built at the South Philadelphia works of the Westinghouse Electric & Manufacturing Co. and installed in the Campbell works at Youngstown.

The turbine will be of the "CW" type operating at 1,800 r.p.m. Steam will be supplied to the throttle at 385 lb. gage pressure, 258 deg. F. superheat and exhaust at a pressure of 6 in. of mercury absolute.

The direct-connected generator will have a rating of 18,000 kw., 80 per cent power factor, producing three-phase 60-cycle current at a potential of 6,900 volts. A direct-connected exciter will also be furnished.

Large High-Pressure Turbine for Pulp and Paper Mills

The Anglo-Canadian Pulp & Paper Mills, of Quebec, Canada, has placed an order through the Canadian Westinghouse Co. with the Westinghouse Electric & Manufacturing Co., for a 7,500-kw. turbine-generator unit. The new unit will be built at the South Philadelphia works and installed at Limoilu, Province of Quebec.

The turbine will be of the non-condensing automatic bleeder type and will operate at 3,750 r.p.m. Steam will be supplied to the throttle at 375 lb. gage pressure, 100 deg. F. superheat, and exhaust against a pressure of 25 lb. gage. The turbine will be so designed as to allow automatic bleeding of over 50,000 lb. of steam at a pressure of 110 lb. gage.

The direct-connected generator will be rated at 7,500 kva., 100 per cent power factor, producing three-phase 60 to 62½-cycle current at a potential of 2,400 volts. A direct-connected exciter will also be furnished.

New Water Power Plant Soon for Montreal Island Power

Plans have been completed by the Montreal Island Power Co. for the construction of a large hydro-electric plant on Back River. All the engineering details have been worked out as planned and everything is now in readiness for the awarding of contracts for the various parts of the work. In fact, the contract for the construction of a railway which will be necessary for the general purposes of the plant's development has already been awarded to the Foundation Company of Canada, Ltd.

It is estimated that the site on Back River, under a head of 26 ft., is capable of developing 65,000 hp., 24-hour power. Construction plans are based on the delivery of 48,000 hp. by the end of 1929, provision being made for increasing the capacity to 65,000 hp. at minimum cost as required. Tenders for 48,000 hp. of turbines will be submitted soon for either six 8,000-hp. or four 12,000-hp. units.

Reel Showing N.A.S.E. Trip Now Procurable

An interesting series of moving pictures showing scenes taken on the trip of the delegates from the East to the national convention of the N.A.S.E. held at Los Angeles last August, were initially presented before a representative gathering of local and national officers of the Association at the New York office of Jenkins Brothers the evening of October 6.

"The Trip That Joe Took" is the title of the film, which was "shot" by Joseph McKenna and Fred Jolly, representatives of Jenkins Brothers. This firm will be pleased to lend the reel to any N.A.S.E. association for exhibition purposes. Application should be made to C. B. Yardley, sales promotion manager at the New York office.

Personal Mention

HARRY C. WILSON, for many years in charge of the boiler shop of the Erie City Iron Works, Erie, Pa., has resigned to engage in business for himself.

PETER G. VAN GILST, formerly member of the Mid-Continent Section of the A.S.M.E., is now with the Kentucky-West Virginia Gas Co., 605 Ashland National Bank Bldg., Ashland, Ky.

C. T. CARLSON, formerly chief engineer of the Erie City Iron Works, Erie, Pa., has become connected with the engineering department of the Casey Hedges Co., Chattanooga, Tenn.

W. C. HECKEROTH, who during the last twenty years has been connected with the Erie City Iron Works, Erie, Pa., as chief engineer, also as sales and combustion engineer, has resigned to become sales manager of the Fuel Efficiency Corp., Birmingham, Ala.

CHARLES L. EDGAR, president of the Edison Electric Illuminating Company of Boston, recently celebrated his 40th service anniversary. Many company directors and employees and a number of pioneers in the electrical field joined in the commemoration.

H. W. EALES, formerly chief electrical engineer of the Union Electric Light & Power Co., St. Louis, Mo., was recently appointed head of the electrical engineering division of the engineering department of Byllesby Engineering & Management Corporation.

W. W. PETTIBONE, formerly assistant chief engineer in charge of pulverized fuel engineering of the Erie City Iron Works, Erie, Pa., has become vice-president and chief engineer of the Fuel Efficiency Corp., Birmingham, Ala., manufacturers of unit coal pulverizer plants.

CHARLES C. PHELPS, combustion engineer, announces the removal of his office from Paterson, N. J., to 30 Church St., New York City, where he will continue to act as representative for the Power Plant Equipment Co., Uehling Instrument Co., A. W. Cash Co., and the Williams Gauge Co. Mr. Phelps solicits inquiries on boiler-room accessory equipment, bearings and other power-transmission equipment.

J. F. TUTEIN, who for the last ten years has been with the Jones & Laughlin Steel Corp., Pittsburgh, as steam engineer, is now connected with The Q-P Signal Co., Boston, as general sales manager. Previous to his association with the Steel corporation he was assistant superintendent of power with the Boston Elevated Railway Co. and previous to that was with the Edison Electric Illuminating Company of Boston.

H. W. BROOKS has resigned as consulting engineer for the Erie City Iron Works, Erie, Pa., to re-engage in private consulting practice with offices in New York and St. Louis. Mr. Brooks is internationally known for his research and development work in combustion and steam engineering. He was formerly fuel engineer for the United States Bureau of Mines and during the War chief of the machinery section, Bureau of Ordnance, United States Navy. He is a member of both A.S.M.E. and A.I.E.E., and of the American Committee, World Power Conference.

Society Affairs

ROCHESTER ENGINEERING SOCIETY—First national meeting of Management Division of the A.S.M.E. will be held in co-operation with the American

Management Association and the Rochester Engineering Society at the Hotel Sagamore, Rochester, N. Y., October 26-27.

A.S.M.E. METROPOLITAN SECTION will hold its fall dinner and smoker at The Hotel Astor, New York City, at 7 p.m., November 4. Reservations may be made through I. L. Martin, A.S.M.E., 29 West 39th St., New York City.

N. A. S. E., CONNECTICUT STATE ASSOCIATION, will give a banquet and dance Saturday evening, Nov. 5, at the Hotel Taft, New Haven, Conn., in honor of National President Elmer L. Bassett. This banquet is being tendered Mr. Bassett by the combined local associations of the National Association of Stationary Engineers in Connecticut, in conjunction with the Connecticut State Supply Men's Association. Tickets will be $3 a person, and can be obtained from George F. Klopfer, 30 East Pearl St., New Haven, Conn.

Business Notes

The HILL CLUTCH MACHINE & FOUNDRY CO., Cleveland, has opened a Metropolitan district office at 30 Church St., New York City, in the charge of Charles C. Phelps, sales engineer.

THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., has appointed E. P. Meixsell, who was formerly assistant sales manager at the Easton plant, manager of the New York office, 136 Liberty St., New York City.

The TIMKEN ROLLER BEARING CO., Canton, Ohio, and M. B. U. Dewar of London, England, have, together, purchased from Vickers, Ltd., all of the capital stock of British Timken, Ltd. This purchase gives Timken complete control of the manufacture and sale of Timken bearings.

THE FALK CORP., Milwaukee, manufacturers of herring-bone gears, speed reducers and flexible couplings, has appointed H. R. Harris, 1123 Metropolitan Life Bldg., Minneapolis, as representative of the company. Mr. Harris will cover the state of Minnesota and also Douglas County, Wisconsin.

STONE & WEBSTER, INC., Boston, have prepared two motion-picture films, one depicting some interesting features in the construction of the Conowingo hydro-electric development, shown before the Technology Club of Syracuse, Inc., October 7, and a reel showing the generation of electricity from coal, entitled "From Coal to Electricity." Both films may be obtained for exhibition purposes by communicating with A. A. Northrop, Stone & Webster, Inc., Boston.

THE READING IRON CO. has appointed J. H. Somerville, who recently was connected with the Philadelphia office of the company, associate of W. J. White, district sales representative at the Baltimore office. Mr. Somerville will represent Reading Iron Co. in the South. C. M. Barr has been appointed to succeed Mr. Somerville in the Philadelphia office, which is in charge of A. R. Kinsler, district sales representative.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Society of Heating & Ventilating Engineers, hold general meeting in New York City, during 4th week in January; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Society of Refrigerating Engineers, annual convention in New York, Dec. 5-7; W. H. Ross, sec., 37 W. 39th St., New York City.

American Water Works Association, North Carolina Section, at Durham, Nov. 7-9; H. G. Baity, sec., Univ. North Carolina, Chapel Hill; Section, at Council Bluffs, Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

American Socity of Mechanical Engineers, convention during week of New York Power Show, New York City, Dec. 5-10; Calvin Rice, sec., 29 West 39th St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 14-17; G. E. Pfisterer, sec., 53 West Jackson Blvd., Chicago.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National District Heating Association, annual meeting in May; D. L. Gaskill, sec. 112 West 4th St., Greenville, Ohio.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 5-10. Address inquiries to the International Exposition Co., Grand Central Palace.

Society of Naval Architects and Marine Engineers, Thirty-fifth general meeting will be held in the Engineering Societies Building, 29 West 39th St., New York City, Nov. 10-11. Papers of interest to power engineers will be offered Nov. 11.

THE COMBUSTION ENGINEERING CORP. announces that Walter Springe, who has represented the Heine Boiler Co. in the Kansas City and St. Louis territories for the past 25 years, has been recently appointed district manager of the corporation for this district. Mr. Springe will handle the sale of all types of steam-generating and fuel-burning equipment for power plants. R. J. Robinson has been appointed as branch manager, under Mr. Springe at St. Louis.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Oct. 5 1927
Pool 1	New York	$2.25@$2.75
Smokeless	Boston	1.48
Clearfield	Boston	1.60@ 1.85
Somerset	Boston	1.70@ 1.90
Kanawha	Columbus	1.50@ 1.75
Hocking	Columbus	1.75@ 2.00
Pittsburgh	Pittsburgh	1.90@ 2.00
Pittsburgh gas slack	Pittsburgh	1.35@ 1.60
Franklin, Ill.	Chicago	2.50
Central, Ill.	Chicago	2.25
Ind. 4th Vein	Chicago	2.50
West Ky.	Louisville	1.50@ 1.75
S. E. Ky.	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.75@ 2.00
Anthracite (Gross Tons)		
Buckwheat No. 1.	New York	2.90@ 3.25
Buckwheat No. 1.	Philadelphia	3.00@ 3.75
Birdseye	New York	1.50@ 1.60

FUEL OIL

New York—Oct. 13, light oil, tank-car lots; 28@34 deg. Baumé, 5c. per gal.; 36@40 deg., 5¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Oct. 5, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.60 per bbl.; 26@28 deg., $1.65 per bbl.; 28@30 deg., $1.70 per bbl.; 30@32 deg., $1.75 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 5¼c. per gal.

Pittsburgh—Oct. 2, f.o.b. local refinery; 30@34 deg., fuel oil, 4½c. per gal.; 36@40 deg., fuel oil, 4¾c. per gal.

Philadelphia — Oct. 5, 26@30 deg., $2@$2.06 per bbl.; 13@19 deg., $1.68@$1.74 per bbl.; 22 plus, $1.79@$1.85; 27@30, $2.10@$2.16.

Cincinnati — Oct. 10, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5¼c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5⅝c. per gal.

Chicago—Oct. 7, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 87½c. per bbl.; 26@30 deg., 90c.; 30@32 deg., $1.05.

Boston—Oct. 10, tank-car lots, f.o.b. 12@14 deg. Baumé, 4½c. per gal.; 28@32 deg., 5.9c. per gal.

Dallas—Oct. 8, f.o.b. local refiners, 26@30 deg., $1.45 per bbl.

Trade Catalogs

BATTERY CHARGING EQUIPMENT—The General Electric Co. has issued bulletin GEA-817 covering battery-charging equipment for electric trucks.

GEARS & SPEED REDUCERS — The D. O. James Manufacturing Co., 1120 West Monroe St., Chicago, has recently issued Catalog No. 133, describing James generated continuous-tooth herringbone gears and speed reducers. Detailed description of the various features of herringbone gears and speed reducers is included, together with complete illustrations of types and installations, and full specifications. It contains complete engineering data and is a book of value to engineers, operating men and users of heavy-duty speed-reducing equipment.

EXPANSION JOINTS—Graydon Manufacturing Co., East Tioga and Memphis Sts., Philadelphia, devotes an illustrated bulletin No. 709 to the description of GraGuy, the Gradon guided expansion joint, which is made with the guide and the stuffing box in one sturdy, rigid piece. Four sizes of joints are pictured, one of the screwed stuffing box type and the others of the flanged stuffing-box type.

CINDERTRAPS—The Green Fuel Economizer Co., Beacon, N. Y., manufacturer of economizers, air preheaters, forced and inducted draft fans, has issued an illustrated leaflet treating of the Green cindertrap, recently put on the market. This new device consists of a battery of elements set vertically and arranged in staggered double rows, mounted in a frame or casing of suitable design and rigidity, ready for installation in a horizontal portion of the smoke flue. The entire unit is placed above a bin or hopper into which the lower ends of the trap elements project.

ELECTRIC TACHOMETERS—The Pyrometer Co., 74 Reade St., New York City, in a 4-page leaflet deals with the Pyro electric tachometers, which are now added to the company's line of simplified pyrometers. A number of illustrations are given covering the two types of generator and several meters. An exhaustive bulletin thoroughly covering the entire line will soon be ready.

PULVERIZERS—The Bethlehem Steel Corp., Bethlehem, Pa., describes and illustrates in Catalog-J the Bethlehem pulverizer, a dry grinding machine of the table roller type, designed for the grinding of dry materials to any fineness up to 325-mesh. It consists chiefly of a revolving horizontal table on which the grinding takes place; an air separator housing which incloses and extends above the grinding table and in which the air separation is effected; a screw feeding device for introducing the material on to the grinding table, and the supporting housing or framework. In addition an exhaust fan and a cyclone collector are provided. The pulverizer operates on the closed air-circuit system, the exhaust air from the cyclone collector being conducted back to the air intake.

COUPLINGS — The Ajax Flexible Coupling Co., Westfield, New York, has recently issued a new general bulletin, completely describing the Ajax industrial shock absorber. This book is complete with illustrations and data and sets forth admirably the advantages of the Ajax rubber bumper coupling.

MOTORS, SWITCHES, METERS, ETC.— The General Electric Co. deals with automatic supervisory equipment cable-type for control and indication of remote power apparatus in bulletin GEA-796; type FT normal starting torque for full voltage starting general purpose squirrel cage motors in GEA-788; magnetic reversing switches CR7009-W3 and W4 for alternating current, 25 to 60 cycles in GEA-813; horizontal edgewise measuring instruments, types H-5 horizontal edgewise ammeters, H-6, DH-5 GEA-819, CR2927 pressure and vacuum switches for alternating and direct current circuits in GEA-821, CR2940 push-button stations for use in the control circuits of all types of magnetic controllers, in GEA-118A.

NEW PLANT CONSTRUCTION

Ala., Birmingham—Alabama Water Service Co., E. Fies, Pres., American Trust Bldg., awarded contract for the construction of waterworks plant at Prichard, including 200,000 gal. reservoir, deep well and service pumps, etc., also plant at Collinsville including 25,000 gal. reservoir, well and service pumps, etc. to Phenix Engineering Co., subsidiary of owners. Estimated cost $75,000 and $60,000 respectively.

Calif., Glendale — Bd. of Education, is having plans prepared for the construction of a high school including central heating plant, etc. on Glenwood Rd. Estimated cost $1,200,000. A. F. Priest, 719 Fay Bldg., Los Angeles, is architect.

Calif., Lankershim—National Ice & Cold Storage Co., 200 Center St., Los Angeles, plans the construction of an ice plant here. Estimated cost $150,000.

Calif., Los Angeles—University of California, awarded contract for a group of buildings including steam heating system, etc. at Westwood Campus to J. C. Bannister, 6331 Hollywood Blvd. and F. Gow, 1350 Clarissa St. Estimated cost $1,494,816.

Calif., Pasadena — Franklin B. Cole, awarded contract for the construction of a 5 story office and theatre building at Colorado and Hudson Sts. to P. A. Palmer, 705 Insurance Exchange Bldg., Los Angeles. Estimated cost $500,000. Elevators, etc. will be installed.

Calif., Redondo Beach—Elks Club of Redondo Beach, is having sketches made for a 7 and 10 story hotel and club building. Estimated cost $1,000,000. Dwyer & Van Dorn, 3142 Wilshire Blvd., Los Angeles, are architects.

Calif., Redondo Beach—Redondo Beach Lodge of Elks, had sketches made for a 17 story hotel and club building including steam heating system, elevators, etc. Estimated cost $1,000,000. Dwyer & Van Dorn, 3142 Wilshire Blvd., Los Angeles, are architects.

Calif., Redlands—University of Redlands, will build a gymnasium including boiler room, etc. by day labor. Estimated cost $200,000. N. F. Marsh & Co., 1012 Broadway Central Bldg., Los Angeles, are architects. Work will be done under the supervision of G. P. Cortner, Bus. Mgr.

Calif., San Francisco—St. Francis Hotel, Powell and Geary Sts., is having plans prepared for the reconstruction of a hotel including electric elevators, etc. on Powell St. Estimated cost $800,000. W. Faville, First National Bank Bldg., is architect.

Calif., Shafter—Shafter Public Utility Dist., plans an election to vote $24,000 bonds for waterworks improvements including deep well pumping equipment, mains, etc.

Conn., Berlin—John Pinches & Sons, 211 Main St., awarded contract for the construction of a woodworking plant including boiler rooms, etc. on Farmingham Ave. to W. H. Allen & Co., Inc., 12 Glen St., New Britain. Estimated cost $40,000.

Conn., Greenwich — St. Lukes Hospital, Post Rd., awarded contract for the construction of two pump houses, etc. to M. Mezzullo, 132 Pearl St., Port Chester, N. Y. Estimated cost $70,000.

Ill., Chicago—R. S. De Goyler & Co., 307 North Michigan Ave., Archt., will soon receive bids for a 24 story apartment including elevators, etc. at 1430 Lake Shore Dr. for W. C. Bannerman & Co., 77 West Washington St. Estimated cost $2,000,000.

Ill., Chicago—Lowenberg & Lowenberg, 111 West Monroe St., Archts., are receiving bids for a 7 story hotel at 321 North Central Plaza for Central Plaza Hotel Corp., 321 North Central Plaza. Estimated cost $500,000.

Ill., Chicago—Pawhattan Building Corp., c/o C. B. Johnson & Son Inc., 306 South Wabash Ave., Contrs., awarded contract for a 20 story apartment building including swimming pool, etc. at 50th St. and Chicago Beach Dr. Estimated cost $2,500,000.

Ill., Chicago—Syndicate, c/o K. M. Yitzbum & Co., 307 North Michigan Ave., Archts., awarded contract for a 14 story apartment building at Sheridan Rd. and Surf St. to Callner Construction Co., 134 North La Salle St. Estimated cost $2,000,000.

La., New Orleans—Flint-Goodridge Hospital, has acquired a site and plans the construction of a hospital including refrigeration and ventilation systems, boilers, elevators, etc. on Canal St. Estimated cost $500,000. Architect not selected.

La., New Orleans—Weiss, Dreyfous & Seferth Inc., Maison Blanche Bldg., Archts., will receive bids until Oct. 20 for an 18 story hotel including steam heating, refrigeration and ventilation systems, boilers, pumps, elevators, etc. on Canal St. for Jung Hotel, Canal and La Salle Sts. Estimated cost $500,000.

Me., Portland—Finks Bros., 235 Middle St., is having plans prepared for a 13 story hotel including electric refrigeration system, etc. on High St. C. L. Lane, 77 Roberts St., is architect.

Mass., Cambridge—Dept. of Public Welfare, will soon award contract for the construction of a city home, power house, etc. on Concord Ave. C. R. Greco, 11 Beacon St., Boston, is architect.

Mass., Somerville (Boston P. O.)—Metropolitan Ice Co., 321 Washington St., awarded contract for the construction of an artificial ice plant at Cottage Ave. and Brookfield St. to E. D. Ward Co., 82 Foster St., Worcester. Estimated cost $60,000.

Mich., Detroit—F. Kern Co., Woodward Ave., awarded contract for the construction of an 8 story stores building to W. E. Wood Co., 1805 Ford Bldg. Steam heating system, boilers, elevators, etc. will be installed.

Mich., Pontiac — Peoples State Bank, North Saginaw St., is having plans prepared for a 14 story bank and office building including steam heating system, boilers, elevators, etc. Estimated cost $1,000,000. Architect not announced.

Mich., South Haven—Leichenko & Esser, 38 South Dearborn St., Chicago, Ill., Archts., are receiving bids for the construction of a hotel and bath house including boiler room and pump house, etc., here for I. I. Cohen. Estimated cost $350,000.

Minn., Minneapolis—Yeates Building Co., E. W. Yeates, Pres., 310 Yeates Bldg., awarded contract for an 18 story office building at 76 South 9th St. to Madsen Construction Co., 618 National Bldg. Estimated cost $1,750,000. Steam heating system, elevators, etc. will be installed.

Mo., Kansas City—Kansas City Power & Light Co., 14th St. and Grand Ave., awarded contract for two complete steam generating units for Northeast and Grand Ave. stations, each unit to deliver 250,000 lb. steam per hr., including Lopulco system for burning pulverized fuel, water cooled furnaces, economizers, air preheaters and superheaters to Combustion Engineering Corp., c/o International Combustion Engineering Co., 200 Madison Ave., New York, N. Y.

Mo., Kansas City—Schloss Memorial Hospital, S. Harzfeld, Pres., 15th and Main Sts., is having sketches made for the construction of a hospital at 49th to 50th Sts. and Rockhill Rd. Estimated cost $1,250,000. Schmidt, Garden & Erickson, 1048 South Michigan Ave., Chicago, Ill., are architects. Greenbaum, Hardy & Schumacher, Scarrett Bldg., Kansas City, Mo., are associate architects.

Mo., St. Louis—P'd. of Public Service, L. Day, Comr., 208 City Hall, will receive bids until Nov. 1, for the construction of a refrigeration plant for city morgue. Estimated cost $17,000.

Mo., St. Louis—Lafayette Realty Co., c/o P. J. Bradshaw, International Life Bldg., Archt., is having preliminary plans prepared for the construction of a 23 story hotel including steam heating system, etc. at 12th and Olive Sts.

Neb., Beaver Crossing—City, P. Mauer, Clk, is having preliminary plans prepared for the construction of a wheel house, etc. in conjunction with present dam for proposed extensions and improvements to hydro-electric plant. Estimated cost $30,000. Grant, Fulton & Letton, 525 South 13th St., Lincoln, are engineers.

Neb., Fairbury—City plans extensions and improvements to water and light plants. Burns & McDonnell, 401 Interstate Bldg., Kansas City, Mo., are engineers.

N. J., Atlantic Highlands—Owner, c/o A. F. Amodio, 45 Branford Pl., Newark, is having sketches made for the construction of a hotel and sanitarium including vapor heating system, boilers, etc. on Mitchell Hill. Estimated cost $1,000,000.

N. J., Belleville—Bd. of Freeholders, H. H. Berg, Supt., Kent House, Newark, is having plans prepared for addition to hospital including steam heating system, etc. on Soho St. here. Estimated cost $1,000,000. D. L. Richardson, 192 Eaton St., Providence, R. I., is architect.

N. J., East Orange—J. B. Peterkin, 285 Madison Ave., New York, Archt., will receive bids about Nov. 1 for the construction of a 10 story apartment building at 39 Prospect St. here, for Thirty-Nine Prospect Street Corp., 790 Broad St., Newark. Estimated cost $1,000,000.

N. Y., Brooklyn—Church Charity Foundation, Albany St. and Atlantic Ave., awarded contract for a 6 story hospital to W. Kennedy Construction Co., 215 Montague St. Steam heating, refrigeration, and ventilation systems, boilers, pumps, elevators, etc. will be installed.

N. Y., Brooklyn—Twenty-Four Monroe Pl. Inc., awarded contract for a 13 story apartment building to D. D. Solomon, 160 Montague St. Estimated cost $800,000. Steam heating and refrigeration systems, boilers, pumps, elevators, etc. will be installed.

N. Y., Long Island City — Bloomingdale Bros. Inc., 59th St. and Lexington Ave., New York, will receive bids until about Nov. 30 for mechanical equipment for proposed warehouse at Hunters Point Ave. here. Estimated cost $500,000.

N. Y., New York—Ridansky & Levy, 424 Madison Ave., will build a 15 story apartment building at 445 East 57th St. Rosario Candela, 578 Madison Ave., is architect. Owner is general contractor.

N. Y., New York—Eight Hundred Twenty Five West End Ave. Corp., c/o I. Polestein, 285 Madison Ave., plans the construction of a 15 story apartment building at 100th St. and West End Ave. Estimated cost $800,000. E. Roth, 1440 Broadway, is architect.

O., Cincinnati—Western & Southern Life Insurance Co., Fourth St. and Broadway, plans the construction of a 14 story office building on Broadway. Estimated cost $1,000,000. A. Wachtel, Avon Bldg., is architect.

O., Cleveland—City, plans an election Nov. 8 to vote $2,425,000 bonds for the construction of a hospital on Scranton Rd. A. Garfield, National City Bldg., is archtect. D. Blossom, Welfare Dir.

O. Cleveland—The City Ice & Fuel Co., E. C. Balzhiser, 6611 Euclid Ave., had plans prepared for the construction of a cold storage plant on Burwell Ave. Estimated cost $500,000. Ball Ice Machine Co., 126 Chouto St., St. Louis, Mo., is architect and engineer.

Okla., Tulsa — Oklahoma National Gas Corp., 117 West 4th St., c/o T. C. Ritts, will receive bids until Oct. 24 for a 10 story office building including steam heating system, etc. Estimated cost $700,000. A. M. Atkinson, Mid-Continental Bldg., is architect.

Pa., Pittsburgh — St. Francis Hospital, 45th St., is having preliminary plans prepared for a 6 story addition to hospital at 45th and Geneva Sts. Estimated cost $1,500,000. S. F. Heckert, Bessemer Bldg., is architect.

Texas—Central Power & Light Co., c/o F. C. Ludden, Mgr., San Benito, is having surveys made for the construction of cold storage plants at Elsa, $35,000; Edcouch, $35,000; Alamo, Raymondsville, Mercedes and Hargill, $45,000; also an ice and cold storage plant at Harlingen, $120,000. Private plans. Complete machinery and equipment will be required.

Tex., Midland—West Texas Utilities Co., Abilene, plans extensions and improvements to ice plant to increase the capacity, also the installation of considerable equipment in light plant. Estimated cost $60,000. Private plans.

Tex., Rio Hondo—City C. A. Mellernee, Supt. of Waterworks, plans waterworks improvements including the installation of a pumping plant, etc. Estimated cost $12,500. Work will be done by day labor.

Tex., Temple—F. Doering, awarded contract for the construction of a 9 story hotel at Fourth and Central Sts. to C. L. Shaw, 767 Lamar St., Dallas.

Tex., Pyote—F. T. Pickrell & Associates, plans the construction of a waterworks system including pumping unit, etc. Estimated cost $30,000.

Tex., San Antonio—Alford Pure Milk & Ice Co., R. W. Alford, c/o Phelps & DeWees, 718 Gunter Bldg., Archts., plans the construction of second unit of ice plant including creamery at Garden, Presa and Devine Sts. Estimated cost $125,000.

Wash., Seattle—H. A. Vance, c/o V. W. Voorhees, Lloyd Bldg., Archt. plans the construction of an 18 story hotel at Third and Union Sts. Estimated cost $1,500,000.

B. C., Vancouver—Vancouver Medical & Dental Building Ltd., 608 Rogers Bldg., is having sketches made for a 10 or 12 story office building at Richards and Georgia Sts. Estimated cost $1,000,000. W. J. Bain, Liggett Bldg., Seattle, Wash., is architect.

Ont., Niagara Falls—General Brock Hotel Co., A. L. Brooks, Pres., 72 Main St., E., Welland, awarded contract for the construction of an 11 story hotel on Ontario Rd. here, to Piggott & Healey Construction Co., 36 James St., S., Hamilton. Estimated cost $1,000,000. Steam heating system, etc. will be installed.

Ont., Toronto—Canadian Bank of Commerce, King and Jordan Sts., is having sketches made for a 10 to 12 story office building including steam heating system, electric elevators, etc. Estimated cost $2 500,000. Darling & Pearson, 2 Leader Lane, Toronto, are architects.

Equipment Wanted

Boiler — R. Dupras, 4389 Christopher Columbus St., Montreal, Que., is in the market for a 35 hp. steam boiler.

Compressors, Motors, Etc. — Linde Air Products Co., subsidiary of Union Carbon & Carbide Co., 30 East 42nd St., New York, N. Y., will be in the market for compressors, motors, etc. for proposed plants at Wichita, Kan., Tampa, Fla., and Grand Rapids, Mich. Estimated cost $150,000.

Engine and Generator—City of Sallisaw, Okla., plans the installation of a 300 hp. Diesel engine and generator. Estimated cost $30,000.

Engines and Electrical Equipment—City of Campbell, Mo., will be in the market for two Diesel engines, also electrical equipment for proposed electric light plant.

Generator—Commissioner of Correction, 353 Broadway, Albany, N. Y., will receive bids until Nov. 1 for furnishing and installing an electric generator at Great Meadow Prison, Comstock, N. Y.

Hoist—H. B. Turner, Cullen, Va., will be in the market for a 5 hp. single drum gasoline hoist, 150 ft., $\frac{5}{8}$ in. wire rope.

Motor Generator Sets, Switchboard, Etc.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Oct. 26 for the installation of 300 and 600 kw. motor generator sets and switchboard, etc. in Navy Yard, Brooklyn, N. Y.

Pump, Etc.—City of Ironton, Mo., will be in the market for a 100 g.p.m. deep well pump, etc. for proposed waterworks improvements. Estimated cost $49,000.

Pump and Motor—City of Mulhall, Okla., will be in the market for a triplex pump and motor, etc. for proposed new waterworks system. Estimated cost $20,000.

Pumping Equipment—City of Gainsboro, Tenn., plans to purchase pumping equipment for proposed waterworks improvements. Estimated cost $15,000.

Pumping Equipment—M. F. Walt, City Auditor, Huron, S. D., will receive bids until Oct. 26 for pumping equipment for proposed waterworks improvements. Estimated cost $75,000.

Pumps and Motors—City of El Dorado, Okla., will be in the market for triplex pumps and motors for proposed waterworks improvements. Estimated cost $91,000.

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